



**The effect of collaborative learning on the  
problem-solving skills of children with Down  
syndrome**

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## ABSTRACT

Down syndrome (DS) is one of the biggest causes of learning disabilities (LD: 'mental retardation' in the U.S.), with the majority of affected persons having moderate to severe learning disabilities. Specific learning problems such as a failure to consolidate new learning and a counterproductive approach to learning have also been identified. Collaborative learning has been shown to be effective in facilitating learning in typically-developing (TD) children but little research has addressed its potential in children with LD. Those studies which do exist tend to be outcome- rather than process-oriented.

This thesis examined the effect of collaborative learning on children with DS through three inter-linked studies. The first study investigated unstructured collaborations on a Lego construction task in children with DS who were paired with developmentally age-matched children with non-specific learning disabilities (NSLD) and in pairs of similarly-matched TD children. Pre- to post-test score comparisons demonstrated significant improvements for the groups of participants overall, but no group differences were found. Qualitative analyses of interactions found no group differences in the proportion of time spent off-task, amount of eye contact or amount of off-task speech. Proportionally, the participants with DS used as much speech indicative of cognitive conflict as the TD participants and showed the least negative speech. They also, however, produced significantly less goal-directed speech than did the TD participants.

The second study sought to determine whether collaboration with a peer could facilitate conceptual understanding in children with DS. Groups of non-conserving children with DS and children with NSLD were paired with conserving children with NSLD on conservation of number and conservation of matter tasks. Following collaboration more than half the participants with DS showed improvements in understanding of conservation of number. The results seem to support the Piagetian notion that socio-cognitive conflict after exposure to a differing viewpoint can lead to cognitive advancement. However, as exposure to a more advanced model also constitutes a tutoring model, the results can equally be interpreted from a more Vygotskian perspective.

The third study assessed the extent to which children with DS were able to benefit from contingent teaching, or 'scaffolding' by comparing the effects on performance on a spatial matching task of two adult-led interventions (direct teaching or contingent teaching) with a control condition. Participants in the contingent condition showed significant pre- to post-test gains as well as improvements on a similar task for which no intervention had been implemented. Participants in the two other conditions showed no significant gains, suggesting that for children with DS, contingent teaching is more effective than strategies in which a solution is explicitly taught.



The findings from the three studies suggest that collaboration, either with peers or adults, may work for children with DS at two levels: at the cognitive level, by encouraging them to reflect on and consolidate existing knowledge, and also at a more affective level, by deflecting counterproductive approaches to problem solving. The findings are discussed with reference to Piagetian and Vygotskian theories of collaborative learning and implications for educational practice are considered.

## **DECLARATION**

This thesis has been composed by me and is entirely my own work.

Karen E. Goodall

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## LIST OF ABBREVIATIONS

DS	Down syndrome
NSLD	non-specific learning disabilities
TD	typically-developing



# CHAPTER 1

## INTRODUCTION

### 1.1 The focus of the thesis

Down syndrome (DS) is the biggest cause of learning disabilities in the UK, affecting approximately one in 700 live births universally (Reeves et al., 2001). Although there is a wide variation in the ability of people affected by the syndrome, most people with DS will have moderate to severe learning disabilities and will have difficulties in mastering many basic academic and life skills. At present there is no indication of a significant reduction in the future DS population (Steele & Stratford, 1995). As there will be a sizeable population of people with DS for the foreseeable future, research which addresses how to help them achieve their full potential remains necessary.

Research investigating cognitive skills has suggested that children with DS may exhibit characteristic approaches to learning (e.g. Morss, 1983; Pitcairn & Wishart, 1994; Wishart, 1993a). This implies that cognitive development may not be simply delayed, but rather that it will deviate from that seen in typical development. For this reason it is important to investigate methods of promoting learning that specifically consider people with DS as a distinctive group of learners.

Collaboration has been known to be an effective method of promoting cognitive development in typically-developing (TD) children. The benefits of group work for

schoolchildren were being advocated as early as the 1960s, for example in the government's 'Plowden Report' (Central Advisory Council for Education, 1967), and there is much evidence to suggest that peer collaboration is an effective form of learning for curriculum subjects (e.g. Howe et al., 1990; Kutnick & Rogers, 1994). In special education, by contrast, the emphasis has remained firmly on individualised, adult-led methods of teaching (Gross, 1996). This tendency towards very individualised teaching methods may have originated in the need to produce an official statement specifying a student's special needs (Department for Education, 1994) which also led to the introduction of individual education plans. Little research has investigated the potential benefits of collaborative learning in children with learning disabilities and even less has considered its possible impact on a specific group such as children with DS.

This thesis aimed to investigate the potential that collaborative learning may offer children with DS. It also includes TD children and children with non-specific learning disabilities (NSLD) to allow comparison of learning outcomes. The theoretical underpinnings of collaboration in TD children are found in the developmental theories of Piaget and Vygotsky. This first chapter therefore describes each of these theories and explores some of the mainstream research literature that has stemmed from these paradigms in order to set the scene for describing the studies in this thesis. The second chapter considers some of the research that has been conducted into the effects of collaboration on atypical learners.

The third chapter provides an introduction to DS and describes briefly the difference/delay debate before going on to outline some of the behaviours that are commonly associated with the DS behavioural phenotype. The intention was to review behaviours that may or may not have relevance in collaborative learning situations for children with DS and to emphasise the need for collaborative research that considers such children as a specific group.

The next five chapters describe in essence 3 studies, one of which was analysed both quantitatively and qualitatively. The three studies examine different aspects of collaboration in children with DS whilst attempting to marry the results to broader theoretical frameworks of collaboration. Chapter nine provides an overview of the results as a whole, again with reference to the broader literature.

## **1.2 Introduction to the mainstream literature on collaborative learning**

Over the past two or three decades a great deal of research has focused on the effect that collaborative learning with either an adult or child partner can have on children's cognitive development. In fact, Light and Littleton (1999) state that, "the capacity for collaborative learning is widely, and perhaps increasingly seen as a key feature of human cognitive development" (1999. p. xiv). On balance, the results from empirical research suggest that collaborative learning can bring positive cognitive benefits to TD children of differing ages and abilities. In presenting the empirical work on collaborative learning in children with DS carried out in the thesis, it is important to first put the

studies in context by reviewing the theoretical background to collaborative learning in the TD population.

Studies examining the effects of collaboration on cognitive growth in TD children have been set within a variety of perspectives, most notably those of Piaget and Vygotsky (for reviews see e.g., Azmitia & Perlmutter, 1989; Tudge & Rogoff, 1989). Although Piaget and Vygotsky were contemporaries, their theories of children's cognitive development are very different and consequently they vary considerably in the slant they put on collaborative learning. The next two sections will briefly review the theories of Piaget and Vygotsky with regard to collaborative learning, before examining findings from research that has been located within each paradigm. Consideration will be given to how the theories of Piaget and Vygotsky may be viewed as complementary rather than oppositional.

### **1.3 Conflict, resolution and equilibration: Piaget's theory of collaborative learning**

Piaget's theory has traditionally been viewed as an endogenous theory of development as it emphasises the child's active construction of knowledge (Piaget, 1953). According to this theory children's development is interactionist, but in the sense that the child is considered to be an active partner while the environment is seen as a passive space in which the child constructs his or her own development. Despite this emphasis on the individual driving his or her own development, Piaget (1932) viewed peer interaction as

a particularly potent source of cognitive progress, especially with relation to the attainment of concrete operational modes of thought in the early school years.

Piaget (1953) proposed that the ability to think logically is attained gradually as the child matures. He proposed that children are unable to reason logically until about the age of six or seven. He termed children under this age 'pre-operational'. An operation may be described as "any representational act which is part of an organised network of related acts" (Flavell, 1963, p.166). Thus children at the operational stage of development are able to store representations in an interconnected fashion and consequently are able to reason logically. Although children at a much younger age are capable of storing mental representations, they are not able to connect these representations in a logical manner. This ability develops gradually until, by about age six or seven, the child is able to logically order mental representations of objects. Piaget called the period from seven to eleven or twelve the period of concrete operations because, although the child is able to think logically, he or she is still tied to his own concrete experiences and is incapable of dealing with abstractions. He called the period thereafter formal operations. This marks the period where the child learns to think abstractly and can begin to theorise

According to Piaget's theory, a major obstacle to the achievement of operational thought in very young children was their egocentric thinking. Piaget's widely misinterpreted notion of egocentrism states that young children have difficulties in focusing on two or more aspects or views of an object or situation simultaneously. Young children tend to

focus on the first relevant factor they note in a given situation and then to 'centre' entirely on that factor (Piaget, 1932). In order to progress from this thinking, young children need to have this 'centration' disturbed. According to this viewpoint, social contact is facilitative in that it provides an opportunity for decentration through exposing the child to differing viewpoints (Piaget, 1985).

Piaget proposed that when the child detects inconsistencies between their own perspective and that of another person, this has the effect of undermining false certainties and throwing the child into cognitive disequilibrium. Disequilibrium is not a state that can be maintained; it leads to epistemic curiosity, a motivational state which entices the child towards a new search for knowledge (Chapman & McBride, 1992). In Piaget's theory interpersonal contact plays a primary role in the development of rational thought, as being exposed to contradictory beliefs provides an opportunity for the child to reflect on the logic of his or her own views and subsequently allows more elaborate views of the world to be constructed than were previously held (Piaget, 1977a).

Three conditions are stipulated under which equilibrium and hence cognitive growth is achieved during collaborative learning contexts (Piaget, 1977a). Firstly, partners must have a common set of intellectual values: that is, they must be able to understand the same language and system of ideas. Secondly, there must be a 'conservation of propositions' or commitment to adhering to what was said originally if children are then to go on to justify their difference in points of view. Thirdly, the partners must work



reciprocally; each viewpoint must be interchangeable and partners must work to understand the other's perspective and be able to compare the two logically.

Although social interaction can help younger children to decentre, children who have reached the stage of concrete operational thinking should benefit more from collaboration than younger peers (Piaget, 1953,1977a) because the young child's egocentrism can block the establishment of reciprocity and co-operation in considering differing points of view. Young children may stubbornly cling to their own viewpoint without any consideration of the conflicting viewpoint of the partner. There is also a lack of conservation of propositions, meaning that each partner does not stand by their original idea long enough for any inconsistency in the two viewpoints to be noted. When lack of conservation of propositions arises, young children will simply drop their viewpoint and adopt that of the other, thereby preventing any further discussion of viewpoints.

The proposed necessity for reciprocity in order to achieve equilibrium in thinking means that Piaget assumed that most discussions with adults would be unlikely to lead to cognitive restructuring. Only when children are able to discuss phenomena as equals can true restructuring take place; interaction with adults lacks reciprocity because all the power resides with the adult and the child has an unquestioning belief that the adult is right. Piaget proposed that when faced with the opinion of an adult, the child would simply abandon their view and take on the opinion of the adult without examination of

the ideas implicit in it. He believed that competent adult teachers present themselves as a cognitive 'equal' of the child in order that discussion and examination of ideas can take place. He stated "Criticism is born of discussion and discussion is only possible amongst equals" (Piaget, 1932, p.409). Consequently, the majority of research in the Piagetian tradition has focused on peers who are considered to be of broadly similar ability level but with differing viewpoints.

Piaget concentrated on the development of the child as an individual, overlaying this with a theory of social influence only when the child was able to appreciate the perspective of another. Neo-Piagetian research, however, has emphasised much more the role of the environment in development, and researchers such as Doise and colleagues (see Doise & Mugny, 1984) have sought to integrate Piaget's sociocognitive theory within the psychosocial theories of Mead (1962) and Vygotsky (1962). The following section considers some of the factors proposed to be effective in bringing about cognitive advancement through peer collaboration in TD children.

### **1.3.1 Socio-cognitive conflict as a precursor to cognitive growth**

A review of the evidence does indeed suggest that when pairs of children solve a problem together they think more effectively than when they work alone (Kruger, 1993). The original neo-Piagetian literature proposed that the main cause of this qualitative shift in thinking is socio-cognitive conflict arising from interaction (e.g. Ames & Murray, 1982; Doise & Mugny, 1984; Doise, Mugny & Perret-Clermont, 1975, 1976; Mugny & Doise, 1978; Perret-Clermont, 1980). Many of these studies involved pairing a

conserving and a nonconserving on a conservation task, followed by a re-test to ascertain whether the status of the nonconserving has changed following interaction with the conserving child. For example, Murray (1982) allowed nonconserving children to either interact with a conserving child or to be trained in conservation by an adult. At the post-test, 80% of the nonconservers were able to conserve following interaction with the conserving child, while only 50% of nonconservers who were trained by an adult were able to do so. It was claimed that cognitive conflict induced by exposure to a differing viewpoint during the social interaction was the driving force behind the gains made in such studies.

It could be argued, however, that such gains may not be due to the process of socio-cognitive conflict, but could be explained in terms of simple imitation of a more advanced cognitive model (Rosenthal & Zimmerman, 1972, 1978). Silverman and Stone (1972) paired nonconservers with conservers and concluded from the unidirectional change towards conservation that equilibration was a more convincing argument than modelling or imitation. In order to test this hypothesis, Rosenthal and Zimmerman (1972, 1978) paired conserving children with adults who gave a non-conserving response and the children did, in fact, regress. However, this happened only when the children were paired with adults, not with other non-conserving children, and was a temporary phase only (Murray, 1974; Robert & Charbonneau, 1977, 1978). Robert and Charbonneau argued that such a result is more likely to be due to asymmetrical power

relations between the child and the adult, in that the child defers to the higher status of the adult even when the correctness of the adult's view is questionable.

While imitation could perhaps be a factor in unequal pairings, it could not be considered to be a factor in cognitive growth where both children are non-conservers. Piaget originally proposed that children who were at the same level of development, but with different perspectives, would be the best combination for cognitive growth. In some cases, differing perspectives have led to cognitive growth even when both perspectives were incorrect (Ames & Murray, 1982; Glachan & Light, 1982). However, the results have not always been conclusive. Russell and colleagues failed to find that socio-cognitive conflict between children of the same ability level facilitated performance in a variety of conservation tasks (Russell, 1981a, 1981b, 1982; Russell et al. 1990). Instead, Russell and colleagues (1990) suggest that advances seen in conservation understanding as a result of collaboration between two non-conservers may not arise out of socio-cognitive conflict between the two children, but may instead occur spontaneously on the individual level as a result of 'intrapyschic' conflict. In most peer collaboration studies children are asked to justify their conservation beliefs on at least three occasions- at the pre-test, during collaboration and at the post-test. Multiple test sessions may provide more opportunity for children to note conflicting aspects in their own explanations, thereby inducing intrapsychic conflict which ultimately leads to conserving. Once one child has begun to conserve, the other nonconserver may simply imitate the response of the newly conserving child. Russell (1990) proposes that this possibility would explain

some of the inconsistencies seen in studies of peer collaboration in that, if control groups also show benefits from repeating the task, it may lead to the conclusion that collaboration in itself is not particularly beneficial.

Although social learning through imitation may play a role in some circumstances, Doise and Mugny (1984) proposed that learning through sociocognitive conflict is a more effective form of learning. Doise, Mugny and Perret-Clermont (1975, 1976) paired non-conservers with an adult who was instructed to give either a conserving response or a non-conserving response that was different to one the child had originally given. Conservation was enhanced (relative to a control group) in both children who were exposed to this non-conserving response and to a conserving response. However, the group who had been given a non-conserving response were better able to generalise to a similar task, indicating that sociocognitive conflict may be more effective than modelling. Further support for the view that cognitive growth is not simply a result of imitation comes from the findings that the justifications provided by new conservers are often novel ones (Perret-Clermont, 1980). This is likely to occur only in situations where some cognitive restructuring had taken place. On balance then, it appears that sociocognitive conflict can be a potent source of cognitive growth, at least in cases where partners are of equal status.

### **1.3.2 Mechanisms for promoting cognitive development in peer collaboration studies**

Cognitive conflict between peers may indeed be a powerful facilitator of learning.

However, the benefits gained from comparing conflicting views among children must be balanced by considering the benefits of children collaborating where the emphasis is much more on agreement than on argument. Light and colleagues (1994) used studies of computer-based collaborative work to demonstrate that children could benefit from working collaboratively, even when there was little evidence of disagreement or argument in relation to those particular tasks (Light et al., 1994). Some studies have even indicated that where consensus is achieved, there are benefits to be had for the more advanced child from working with a lower ability child (e.g. Forman & Kraker, 1985; Glachan & Light, 1982; Light & Glachan, 1985).

In addition, Tudge (1990) noted that studies which emphasise the role of socio-cognitive conflict in promoting cognitive development could be interpreted in a different fashion. He notes that most Piagetian-inspired research is based on conservation tasks where non-conservers are typically paired with conservers (e.g. Ames & Murray, 1982; Doise, Mugny & Perret-Clermont, 1975; Light 1983, 1986; Murray, 1982, 1983; Perret-Clermont, 1980; Tudge, 1989, 1992). Nonconservers and conservers are classed as having different perspectives according to this paradigm. However, conservers and nonconservers may have more than differing perspectives: conservers have a perspective that conforms more to reality than the perspective of the non-conserver. In essence, it may then be considered as more advanced. Some authors have argued that children will



be most likely to advance their thinking when confronted with a perspective that conforms more to reality than their opinion does, especially if it is at level just beyond that currently held (e.g. Azmitia, 1988; Kuhn, 1972; Mugny & Doise, 1978). In light of this, Tudge (1990) claims that findings from studies of conservers and non-conservers are also consistent with Vygotskian theory in the sense that a less advanced child is guided to the right answer by the hints and prompts provided by a more advanced child. The benefit of working with a partner who is only slightly more advanced can also be translated into Vygotskian terms as an expert and novice working at the edge of a child's zone of proximal development.

As well as having a perspective that is factually advanced, conservers tend to be more confident of their position than nonconservers (Miller, 1986). Tudge (1992) has suggested that confidence may play a role in determining whether collaboration will lead to cognitive gains or not. Using Siegler's (1981) balance beam problem, Tudge showed that when children were more competent but not necessarily more confident, the results varied more. In contrast, when one partner was more competent and confident in his or her predictions, the collaboration was more likely to be fruitful. Tudge also found that interaction with children of the same or a lower level of competence could lead to regression rather than progression. Tudge explained this by proposing that children who hold indeterminate predictions often regress to the less sophisticated rules of their partner, even if the predictions made by these rules are false. Thus it is the confidence of each child in his or her own perspective which will influence whether or not

collaboration will lead to cognitive gains. Ellis and Siegler (1994) also reported that children improved more if their partner was consistently, rather than inconsistently, correct in his or her responses. They also noted that the partners who were consistently correct in their responses tended to provide more convincing arguments. This may be a crucial factor. Children who are very confident in their beliefs may not only be able to predict with confidence, but may also be able to provide a more competent argument to convince the less competent child of *why* they are right.

### **1.3.3 The importance of shared dialogue and active involvement**

The fact that children who are more confident of their view are more likely to elaborate their argument is an important point as it makes it apparent that a more competent partner is not the sole requisite for cognitive gains. Superior knowledge may be of little use if that knowledge is not explicated. Indeed, Russell (1982) found that improvement was only likely when the more advanced child provided an explanation for his or her reasoning. Discussion and sharing of perspectives may therefore be a crucial aid to cognitive growth.

There is some indication that collaboration is more likely to lead to cognitive growth when both children are actively involved in a social dialogue (Bearison et al., 1986). Children who argue little are less likely to benefit than those who become actively engaged in discussion of the task (Light & Glachan, 1985). Peers who engage in either no arguments or a very large number of arguments are less likely to benefit from interaction than pairs whose interaction was more balanced (Bearison et al. 1986). Also,

when one partner dominates, rather than both partners working together, the cognitive benefits are less (e.g. Glachan & Light, 1982; Light et al. 1987). All these studies point to the fact that advanced thinking cannot be instructive to another unless the steps leading to that advance in thinking are explicated. The active engagement of children in argument may facilitate this process, in the sense that the more advanced child is encouraged to counter the less able child's arguments by verbally unpacking his or her own argument. The fact that more favourable results are seen when there is an active debate may be due to the fact that each time the less able child states his or her views, the more competent child must operate on that level of reasoning, thereby providing the less able child with an explanation that is contingent upon that child's own beliefs. Some researchers also stress the importance of 'transactive' discussion which may be described as reasoning about the partner's reasoning (Kruger & Tomasello, 1986).

Argument per se may not be wholly predictive of a positive outcome. There is also some evidence to suggest that shared *resolution* may be important in promoting development (e.g. Kruger, 1992, 1993; Kruger & Tomasello, 1986; Light & Perret-Clermont, 1989). Conflict without resolution is less likely to result in cognitive growth, possibly because a lack of resolution suggests that the children have not actively argued their point or operated on the statements of the other to the point where the two views may be reconciled. When no resolution is reached, this suggests that each child has perhaps clung fast to his or her original view, unconvinced by the argument of the other child.

In summary, while socio-cognitive conflict between peers has been demonstrated to play a role in the cognitive gains seen in peer collaboration studies, the role it plays may not be as strong as was suggested by Piaget and the neo-Piagetians. Although socio-cognitive conflict seems to be an important precursor to cognitive change, reaching consensus may be as important a factor in promoting cognitive gains. Research has also highlighted the importance of dialogue and of active involvement in promoting positive outcomes.

#### **1.4 Vygotsky's socio-historical account of collaborative learning**

While Piaget concentrated on the individual as the unit of analysis, Vygotsky (1962, 1978) argued that the only unit of analysis suitable for the study of development is social activity. This belief is a reflection of the major tenet of Vygotskian theory, that the development of the individual is inextricably linked to the cultural environment and vice versa. From the point of view of both Vygotsky and Piaget, the child actively explores and interprets the world. However, in Piaget's view, the child independently explores a factual world. In Vygotsky's view, there is no concrete reality that constitutes the world outside the child. The child must come to terms with and interpret a physical and social world that has already been interpreted by previous generations of that culture.

Vygotsky, like Piaget, recognised that the development of mental capacities is reliant upon biological maturation. However, he saw the development of 'higher mental functions' as having predominantly social origins. By 'higher mental functions'

Vygotsky meant mental processes over which we have voluntary control and reflective processes of thought – verbal thought, voluntary memory, attention and reasoning. These higher mental functions are facilitated by society through supportive social interactions and through the provision of tools for thinking. All higher intellectual functions depend on symbol systems and on practices that have been handed down through a particular culture and include stores of knowledge and established practices for reasoning and problem solving as well as aids to thinking such as abacuses, calculators and computers. Consequently, thinking is inevitably shaped by the practices and resources of a particular culture. Knowledge appears first on the external social plane before it is internalised by the individual (Leontiev, 1981). Thus achieving one's cognitive potential occurs when working under the guidance of a person who has more knowledge of the cultural environment (Vygotsky, 1978). Unlike Piaget, who proposed that the most productive collaboration takes place between cognitive equals, Vygotsky believed that advancement occurs only when a child collaborates with a more advanced child or an adult. Bruner (1990) uses the analogy of a newcomer entering a play in progress to illustrate this process. The newcomer has little knowledge of the structure or script of the play but those already taking part in the play have enough knowledge to be able to guide the newcomer and to incorporate the newcomer's dialogue into the existing script.

#### **1.4.1 The zone of proximal development**

According to Vygotsky's theory, the adult or competent peer assists the child by tutoring them within what Vygotsky refers to as the child's zone of proximal development

(Vygotsky, 1962, 1978). The zone of proximal development is the area between the child's actual developmental level and the level the child can attain with help. Vygotsky himself defined it thus:

"The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers."

(Vygotsky, 1962, p.86)

The zone of proximal development has implications both for the way children are assessed, and for the optimal method of instruction. According to Vygotsky, measures of what the child can achieve unassisted are not a true measure of the child's development, as such measures tap only functions which have already matured. The level that the child is able to achieve with assistance is thought to be a truer measure of development, since this taps functions that are currently maturing. For example, two children may be able to reach the performance level of a seven-year old on a given task without help, but if one child can reach the level of an eight-year-old with help and the other child can be helped to achieve the level of a ten-year-old, the two children are clearly not at the same level of functioning. The zone of proximal development also has implications for optimal teaching in that according to Vygotsky, the level of adult regulation that best drives

forward development is that which is just slightly ahead of the child's level of mastery (Wertsch and Rogoff, 1984). Vygotsky states:

“...the only good kind of instruction is that which marches ahead of development and leads it; it must be aimed not so much at the ripe as at the ripening functions.”

(Vygotsky, 1986, p.188)

It should be noted that Piagetians would be likely to view attempts to instruct children who are not ready to do things alone as “premature, misguided efforts that result in rote learning or the acquisition of empty, ‘procedural’ knowledge” (Wood, 1988, p.98). However, from a Vygotskian viewpoint, development does not occur through the child's independent exploration of his or her world. Neither does it depend upon a unidirectional flow of knowledge from the teacher to the learner. Rather, it is a dynamic, collaborative activity between a more skilled and a less skilled member of a community. The child is an active seeker of opportunities to learn, and willingly takes on responsibility for the task as his or her capabilities grow.

Wood and colleagues neatly demonstrated some of the mechanisms thought to steer learning in the zone of proximal development by investigating mothers teaching their three- to four-year-old children a task that required conceptual understanding (Wood and et al., 1976). The task in question was one which, according to Piaget's theory,



pre-operational children would not be able to master. In line with Piaget's theory, children under the age of seven were unable to master the task alone. However, after being taught by their mothers, some three-year-olds were able to do so. Wood and colleagues proposed that the mothers of the successful children were able to keep their children on-task while they taught them some simple techniques to guide them in solving the task. While Vygotsky did not specifically state how an adult or more expert peer might promote learning in the child, a number of research studies have attempted to identify the mechanisms through which such a context might promote learning (e.g. Foot, Morgan & Shute, 1990; Wood et al. 1995; Wood, Bruner & Ross, 1976; Wood, Wood & Middleton, 1978). The next section will briefly consider how instruction can be tailored to be sensitive to the child's zone of proximal development.

#### **1.4.2 Scaffolding in the zone of proximal development**

Wood, Bruner and Ross (1976) introduced the metaphor of "scaffolding" to help describe the ways in which caregivers organise their instruction based around the child's current level of understanding in order to provide a structure within which different stages of the task can be made manageable. In the same way that a scaffold provides a framework to support a building while it is under construction, the adult provides a scaffold upon which the child can build knowledge. It is the adult's "loan of consciousness" (Bruner, 1986) which provides the child with a framework within which to make sense of the task before he or she is able to appreciate its full significance.

The landmark study of Wood, Bruner and Ross (1976) provided much fine-grained information on how scaffolding works. It was based on observations of Ross tutoring 30 children individually in building a pyramid out of interlocking wooden blocks. Wood, Bruner and Ross identified the following scaffolding procedures:

*recruitment* – the tutor must recruit the child's interest in the task and also indicate to the child the importance of adhering to 'the requirements of the task'

*reduction in degrees of freedom* – this involves the tutor 'scoping down' the task in terms of the number of choices and decisions that the tutee must make

*direction maintenance* – the tutor must keep the tutee on track in pursuit of a particular objective

*marking critical features* – the tutor must highlight relevant features of the task

*frustration control* – the tutor must help children manage their emotions in a way that helps them stay on task

*demonstration* - ideally, tutors demonstrate in a very interactive way, basing demonstrations on a diagnosis of what the child is trying to do, then modelling a more appropriate procedure

The most salient aspect to come out of this study was the fact that good tutoring depends on interactive processes and does not involve a uni-directional flow of information.

Although Vygotsky's theory of development has been termed a 'transmission' account, he did not view the child as a passive recipient of information. Vygotsky proposed that learning and teaching involve negotiation between the viewpoints of both the child and the teacher. Learning is progressed not only by the teacher but also by the novices' own initiative in observing, imitating and making suggestions" (Azmitia, 1988). The zone of proximal development is not about the teacher simply providing hints and assistance which help take the child to the upper levels of his or her capabilities. Just as a scaffold is removed once a building is able to stand alone, once children have developed an understanding of a task, the adult is able to transfer responsibility for the solution to the child who is then able to regulate his or her own efforts.

Many of the findings in the work of Wood and colleagues have been supported by subsequent studies (e.g. Moss, 1992; Pratt et al., 1992; Rogoff, Ellis & Gardner, 1984; Saxe, Guberman & Gearhart, 1987; Wertsch et al., 1980) and have been consistent with the Vygotskian theory of the zone of proximal development. For example, Moss et al. (1992) indicated three recurrent themes to successful scaffolding strategies. The first was to introduce new skills that the child would not be able to handle unaided for some time. The second was to consolidate tactics that the child had already mastered, while the third was to inhibit actions that were developmentally immature and which were counterproductive with regards to the task at hand.

Neo-Vygotskians have elaborated Vygotsky's cultural transmission account but have remained true to the idea that a more competent partner guides a less competent partner in the "zone of proximal development" towards a shared understanding (e.g. Forman, 1987, 1992; Forman & Cazden, 1985; Tudge, 1992; Wertsch & Hickmann, 1987). This 'social constructivist' viewpoint has been extended by more contemporary researchers to include collaborations between children of similar ability levels (e.g. Forman & McPhail, 1993, cited in Forman & Larrae-amendy-Joerns, 1995).

#### **1.4.3 Individual variability in tutoring ability**

As described above, collaboration is very much a two-way process therefore variability in the results of studies set within a socio-constructivist framework may be partly explained by the ability of the more able partner to act as a tutor. Tutoring is a highly skilled activity at which some people may be more adept than others. Wood, Bruner and Ross (1976) proposed that good tutoring depends on an interaction between two models in the tutor's mind: a model of the task itself and its requirements and a comparative model of the performance and expectations of the tutee. It is not a static process: once the child has moved up in his or her development, the tutor must raise the stakes and encourage the child to stay close to the edge of their zone of proximal development, rather than remaining happily in a 'comfort zone' of skills they have already mastered. Good tutoring must also take account of the developmental level of the individual child. For example, Ross found that with younger children the tutor's actions were geared to keeping the child's attention on the task, whereas with older children, the tutor's main role was in confirming and checking the child's own construction activities (Wood,

Bruner & Ross, 1976). Wood and Middleton (1975) noted that effective tutoring is also active problem-solving for the tutor himself as he or she must develop and test out hypotheses about the tutee's understanding. This goes some way towards explaining why there are benefits in taking on the role of tutor as well as the role of tutee (Maheady, Harper & Mallette, 1991). This extra benefit has been exploited in the concept of reciprocal teaching where children are given guidance on how to ask each other productive questions so that each can test the other's comprehension in a structured way (e.g. Fantuzzo & Ginsburg-Block, 1998).

#### **1.4.4 The role of peers as tutors**

While the literature on adult scaffolding has tended to confirm the benefits of skilled tutoring, the literature on peer tutoring tends to be less conclusive. There is some evidence to show that school-age children are able to benefit from peer tutoring (Wood et. al, 1995), and even a suggestion that very young children may benefit from it (e.g. Azmitia, 1988; Cooper, 1980; Koester & Bueche, 1980). However, this is disputed by other researchers such as Gauvain and Rogoff (1989) who found that pre-school children who worked together on an errand-planning task performed no better than children who worked alone. However, the children who had truly collaborated with their peer partner on this task performed better than those children who did not collaborate well or those children who had worked alone on the task. From this it may be concluded that the tutoring skills of children vary greatly.

From the studies reviewed in the previous section, it is apparent that taking on the role of tutor may require a high level of interpersonal and metacognitive skills, which many children may not yet possess. Ellis and Rogoff (1986) noted that peer tutors tend to find it difficult to tailor their instruction to the right level for the target child. Ellis and Rogoff (1982) found that learners' interactions with adults "appeared to involve more effective guided participation" than their interactions with peers. For example, evidence of adjusting the collaboration so that the learner was challenged yet still able to participate was not observed as frequently in the actions of peer tutors. Another problem which commonly arises is a reluctance in the child teacher to hand over responsibility for a task once the learner has gained control of it (Bruner, 1986). Most adults will already possess many of the skills required for effective tutoring, although individual variation in competence will of course exist.

One reason why pre-schoolers may not be as effective at collaboration is that they give fewer verbal explanations and are less likely to engage in task-related discussion (Cooper, 1980; Koester & Bueche, 1980). It may be the case that very young children are not able to engage in task-related discussion until they are able to hold in mind their own point of view and the view of another simultaneously. Theoretical accounts of collaboration that are based around Vygotskian theory put as much emphasis on the role of talk in the collaboration as do theories based on the notion of cognitive conflict. In fact, considerations of successful dyadic interaction stress the importance of the communicative exchanges that occur in joint problem-solving (e.g. Ellis & Gauvain,

1992). Teasley (1995) investigated whether improvement in performance could be related to simply talking aloud and found that the benefits of talk were more pronounced when children talked with a partner than when they talked to themselves. From this finding, Teasley proposes that it is not collaboration per se that leads to learning, rather that collaboration increases the likelihood that children engage in the kinds of talk that support learning.

The relative benefits of peer or adult tutors may also interact with the nature of the task to be completed. In her reviews of peer tutoring research, Rogoff (1986, 1990) proposed that while certain tasks benefit from the guidance of an adult or a more knowledgeable peer tutor, others appear to work better in a more equal collaborative learning approach. It seems that the imparting of new facts is best scaffolded by an adult or more knowledgeable peer. Indeed, when it comes to skill learning, adults seem to be more effective tutors than peers, for example in planning (Radziszewska & Rogoff, 1988) and on memory and classification tasks (Ellis & Rogoff, 1982; 1986). In contrast, where children are expected to re-conceptualise an area of knowledge or where discussion or argument is involved, peer collaboration can be extremely effective (Kruger & Tomasello, 1986). This may be because peers have no asymmetry of power and use a language that is common to both of them. This is corroborated by Kruger (1992) who found that children were more active in discussions with other children than they were with adults.



#### **1.4.5 Emphasis on co-construction of knowledge**

Just as studies have confirmed that tutoring between adult and child partners is very much a two-way process, Vygotskian accounts of peer tutoring highlight the need for active involvement of both partners. Whilst the neo-Piagetians emphasise the role of conflict in learning, the neo-Vygotskians place great emphasis on the joint construction of knowledge and propose that greater benefits will accrue when partners reach consensus. For example, Martin (1985) noted that cognitive benefits were most likely to occur in a balance scale task when children co-ordinated their exploration of the task, while Rubtsov (1981) noted that children's understanding of classification and complex construction improved after joint problem-solving. Whilst it is accepted that a difference in perspective between peers is useful, the most critical element in any interaction is the peers' attempts to co-ordinate their perspectives to arrive at a solution, one to which both of them have contributed (see Forman, 1987; Forman & Cazden, 1985; Forman & Kraker, 1985). Thus the emphasis is not on cognitive conflict, but on being able to co-ordinate and regulate the interaction and ultimately achieve a joint solution.

### **1.5 Overview**

This chapter has reviewed the evidence for the benefits of collaborative learning from research carried out in the Piagetian and Vygotskian traditions. Researchers in the Piagetian tradition have focused on peer collaboration, that is collaborations between peers of similar ability but differing viewpoints, although some have argued that the conservers and non-conservers typically seen in such studies are of unequal rather than equal ability. Research in the Vygotskian tradition has concentrated more on 'peer

tutoring' designs which comprise of an expert child partner and a novice child partner, or alternatively have focused on adult-child pairings.

At first glance, the theoretical positions of Piaget and Vygotsky appear to be diametrically opposed. Some of the findings by neo-Piagetian and neo-Vygotskian researchers suggest, however, that the mechanisms proposed for cognitive growth through social interaction may actually be complementary. While Piaget proposed that socio-cognitive conflict played a predominant role in cognitive growth and Vygotsky emphasised the role of the co-construction of solutions, some of the processes surrounding the interaction are clearly common to both theories. Both emphasise the need for both partners to actively engage in problem solving, whether verbally or non-verbally. It is through active engagement with another person that resolution can be reached, either intrapsychically – when the child is forced to reflect on his own thinking or interpsychically - when both children arrive at a solution jointly. The importance of dialogue is also apparent; without shared dialogue there is no mechanism for guiding cognitive growth.

The perceived differences in emphasis between the two theories may be partly related to the tasks typically chosen in studies working within the two theoretical frameworks. In Piagetian type tasks, peers often have opposing views that must be argued out. In Vygotskian-inspired tasks, the tasks often do not have a completely right or wrong way to do them and the emphasis is much more on finishing the task rather than arguing out

differences in opinion. In the Piagetian model, social conflict leads to intrapsychic conflict. In Vygotskian-inspired tasks, children work with more advanced partners to create a solution that is greater than the child could construct alone. However, the common thread in both theories is that of interpsychic co-ordination: the ability to regulate and co-ordinate a discussion in a controlled manner, whilst taking on board the perspective of another and incorporating that into one's own scheme. Evidence from research based on both theoretical backgrounds indicates the necessity for active participation and good intersubjective processes if collaborative learning is to be successful. When these prerequisites are achieved, collaboration with either a peer or more advanced partner can have positive cognitive benefits for typically-developing children. The next chapter will now consider how the research findings relating to collaboration in atypical learners fits into the Vygotskian and Piagetian models of collaborative learning.

## **CHAPTER 2**

### **THE EFFECTS OF COLLABORATIVE LEARNING ON ATYPICAL LEARNERS**

#### **2.1 The need for research into collaborative learning in children with moderate to severe learning disabilities**

Taken together, the findings from research on typically-developing (TD) children suggest that collaborative learning with both adult and peer partners can have beneficial effects on learning. There has also been much interest in the potential effect of collaborative learning and in particular peer tutoring contexts, on the academic and social performance of atypical learners. There exists a large North American literature considering the effects of collaboration on children with learning disabilities in the U.S. meaning of the term. This term is used to describe children of at least average intelligence who, for no obvious reason, experience great difficulty in learning basic academic skills (American Psychiatric Association, 1994) and includes conditions such as dyslexia or specific reading problems. This is obviously very different to the U.K. term 'learning disabilities' used within this thesis. The formal UK definition of learning disabilities refers to:

- A significant intellectual impairment, and
- Deficits in social functioning or adaptive behaviour
- Which are present from childhood

Significant impairment is usually defined as an intelligence quotient (IQ) score of more than two standard deviations below the general population mean. This is equivalent to an IQ below 70 on recognised IQ tests (Learning Disabilities. The Fundamental Facts, 2001). Learning disabilities have also been further classified by level of impairment. Generally, four categories are recognised: mild (IQ 50-69); moderate (IQ 35-49); severe (IQ 20-34); and profound (IQ below 20) (WHO, 1992). These categories are similar to U.S. definitions of mild (IQ 55-69), moderate (IQ 40-54), severe (IQ 25-39) and profound (IQ below 20 or 25) mental retardation (Hodapp, 1998).

There has also been much research concerned with the effects of collaboration on children with emotional and behavioural difficulties (e.g. Locke & Fuchs, 1995; Scruggs et al., 1986; Stowitschek et al., 1982). However, there is a distinct lack of research which considers its effect on children with moderate to severe learning disabilities.

Given the dearth of research into collaborative learning in children with learning disabilities, it is perhaps hardly surprising that even less consideration has been given to research into collaboration in children with specific aetiologies for their problems in learning, such as Down syndrome (DS). Implicit within this assumption seems to be the view that children with a lower than average IQ are unlikely to benefit from the indirect learning opportunities provided within collaborative contexts. This is a curious assumption to make given that even fairly young TD children have been shown to

benefit from collaborative learning situations (e.g. Azmitia, 1988; Cooper, 1980; Koester & Bueche, 1980) and that there is some evidence to suggest that children with DS may have the propensity to be more task-focused in social situations (e.g. Ruskin, Kasari, Mundy & Sigman, 1994b). This will be discussed further in Chapter 3. It should be noted that throughout the rest of this chapter the term 'learning disabilities' will be used in the U.K. definition of the term.

## **2.2 The lack of process-oriented collaborative research in children with learning disabilities**

In addition to assessing learning outcomes, the research into collaboration in TD children has been very much process-oriented. That is, it has also considered the processes within the collaborative experience that might account for the positive outcomes seen. As described in Chapter 1, the processes which have been considered in the TD literature include the effects of socio-cognitive conflict, dialogue and scaffolding of learning, as well as the need for active involvement and reaching consensus. Research concerning the effects of collaborative learning in atypical learners has tended to be much more outcome-oriented. That is, much more emphasis has been placed on examining whether or not collaborative learning can be of benefit to atypical learners in terms of outcome, while little emphasis is placed on the processes that might lead to cognitive benefits. This is perhaps a reflection of the belief that there is a lesser need for theory in special education as educators struggle to provide learning contexts that work in practice. Mallory and New lament the fact that much of the special education field

“continues to operate at the level of ‘concrete operations’ when it comes to an understanding of how young children learn and develop” (1994, p.322). Little research has been undertaken on peer collaboration from within a Piagetian framework where the emphasis lies on the child directing his or her own learning. Instead the majority of studies rely on a tutoring design, where the peer is usually an adult (e.g. Levine, 1993) or a TD child and where the focus tends to be on how much the more competent partner can ‘teach’ the atypical learner. Reid (1998, p. 387) notes that “special educators generally believed that what was loosely termed ‘Piagetian theory’ was an inappropriate framework for students with learning disabilities, whom they perceived as essentially inactive participants in instruction who depended on external controls for success”. Added to this, is the fact that the research on peer tutoring in children with learning disabilities is often divorced from its theoretical Vygotskian background and instead, subscribes to a rather more didactic approach, where the more able child ‘teaches’ the less able child. Again, this is somewhat surprising in view of the literature which emphasises the need for active involvement in promoting positive collaborative outcomes (e.g. Azmitia, 1988; Azmitia & Hesser, 1993).

The next two sections will therefore examine the literature which has investigated the effect that collaboration has been shown to have on the social and academic skills of atypical learners.



### **2.3 The effect of collaborative learning on social interaction in atypical learners**

While the mainstream literature on peer tutoring in TD children has focused on cognitive and academic skill acquisition and concept development, the literature on children with problems in learning has tended to address less academic aspects of education. Much of it has focused on increasing the social acceptance of learning-disabled children and on improving social interactions between atypical learners and their TD peers. Peer tutoring contexts are well suited to this purpose as it has been noted that it is easier for children with problems in learning and TD children to interact within the socially-structured confines of the tutoring session (Osgusthorpe, 1984; Rynders et al.,1980).

Such research has been shown to facilitate positive effects on social interaction between TD children and atypical learners. For example, Custer and Osgusthorpe (1983) trained students with learning disabilities (U.S. definition) to act as sign language tutors to TD peers in a highly structured environment. After 8 weeks, interaction between the two groups increased from 5 to 46 percent of available free play time. Similarly, in a meta-analysis, Johnson and Johnson (1983) compared co-operative, competitive and individualistic conditions and between TD children and children with Learning disabilities (U.S. definition). A co-operative structure is one in which individuals are able to reach their goals only if all members in the group work together to achieve their goal (Deutsch, 1949). Johnson and Johnson found that co-operative experiences promoted greater verbal and social interaction between TD children and the learning

disabled children than competitive and individualistic experiences. Similar results were obtained by Putnam et al. (1989). Gains in social interaction have also been found for reverse-role peer tutoring, where the atypical learner takes on the role of the tutor (e.g. Eiserman et al., 1987; Osguthorpe 1984, 1985; Osguthorpe and Scruggs, 1986). There is also some evidence to suggest that tutoring studies between TD students and students with more substantial learning disabilities can have a positive effect on social interaction skills (e.g. Haring et al. 1987; Martella et al., 1995). In one of their studies, Martella and colleagues trained a TD peer tutor to provide appropriate commands and praise to a fourteen-year-old boy with DS. They noted that as “[an]...effect of the training program, the student’s aberrant behaviours decreased and his compliance to requests improved”.

The question of whether peer-tutoring contexts can improve the self-esteem of atypical learners has also been investigated (e.g. Cook et al., 1986; Osguthorpe & Scruggs, 1986; Scruggs & Richter, 1988). The results have been variable. Mathes and Fuchs (1994) reported no effect on global self-esteem measures. It seems to be a common assumption that taking on the role of tutor will lead to improvements in self-esteem as the children can then view themselves in a position of relative responsibility, but perhaps the tutors do not view it in this way. Some (e.g. Heward, 1996) believe that there is no reason to assume that self-esteem in academically low-achieving children will be low anyway.

## **2.4 The effects of collaborative learning on academic performance in atypical learners**

Although fewer studies have been carried out on tasks of academic performance, it is apparent that peer tutoring can nevertheless be an effective tool for atypical learners. There is evidence to suggest that being tutored by a TD child can be effective for the attainment of academic skills in children with learning disabilities (e.g. Kamps et al., 1989; Stainback et al., 1983). In addition, some studies have shown atypical learners to be effective tutors.

In a study of emotionally disturbed pupils acting as tutors for children with learning disabilities, Maher (1984) demonstrated that the percentage of items correct on quizzes and tests increased from 65% to 88% after tutoring, stabilising at 90% during follow-up. In addition, the percentage of assignments completed by the tutees increased from 66% to 94%, stabilising at 90% during follow-up. Gains were also made by the tutors.

In role-reversal peer tutoring, students with learning difficulties have also proved to be competent tutors. In a study of children with mild learning difficulties and behaviour disordered pupils who alternated tutor and tutee roles, significant gains in reading tests scores were made for both groups when compared to control groups (Osgusthrope & Scruggs, 1986). Similarly, Cook et al. (1986) demonstrated that tutors with mild learning disabilities (U.S. definition) could effectively tutor children with more substantial learning difficulties in reading. One area which has commonly been employed in

tutoring schemes with children with learning difficulties is sign language. Custer and Osgusthrope (1983) showed that after 8 weeks of tutoring with children with learning disabilities (U.S. definition) acting as tutors, the TD peers retained 99% of the signs they had been taught, while the peers with learning difficulties retained 94% of the signs they had learnt for the tutoring exercise.

The evidence for atypical learners acting effectively both as tutors and tutees is then positive. In a meta analysis of peer tutoring Cook et al. (1986) concluded that tutoring is a powerful method of intervention for atypical learners and that even children with learning disabilities can function as competent tutors. However, it remains a fact that the majority of research in this area is undertaken with children with learning disabilities in the U.S. definition of the term. It is worth noting once more, that this term refers to children of normal or near normal IQ, while children with learning disabilities in the U.K. definition of the term (i.e.  $IQ < 70$ ) do not generally feature. In addition much of the research focuses either on improving the social skills of atypical learners or increasing acceptance of them by TD children. Given that socio-cognitive conflict in collaborative learning contexts has been shown to be a fairly effective facilitator of learning in TD children the lack of research of this kind in children with learning disabilities is particularly puzzling. A detailed investigation into why this should be the case is outwith the scope of this thesis but one could speculate that children with more marked learning disabilities may have been considered to be unsuitable for tutoring studies as they are likely to require more structured supervision. One could also speculate that most of the

little research undertaken focuses on social acceptance and self-esteem as a reflection of recent ideologies which promote mainstream acceptance of all people with learning disabilities.

## **2.5 Scaffolded learning in atypical learners**

One area of the collaboration literature where children with learning disabilities have been included is in studies of scaffolding. Such research tends to be theory-based, in that it is situated within a social constructivist or Vygotskian framework and as such relates its findings to the broader Vygotskian literature. One such example, is Levine's (1993) study of interactions between pre-school age children with learning disabilities (U.K. definition) and their mothers on a shoe sorting task. Levine found that while there was wide variation in the types of assistance provided, mothers of children with learning disabilities did provide scaffolding-consistent instruction twice as often as scaffolding-inconsistent instruction. However, while the assistance provided was contingent, the mothers in this study did not exploit opportunities to link the task to broader experiences.

There have also been studies which have compared the effect of different types of instruction on the learning outcomes of atypical learners. Bos and Anders (1990) compared the effect of adult partners employing either 'interactive teaching' or 'definition instruction' in a group of students with reading difficulties. The definition instruction condition was based on direct instruction techniques including recitation,

memorisation and teacher feedback. Students in the interactive teaching condition learned more than the students in the control condition as assessed by multiple choice test of the content of the texts used. Similarly, Englert et al. (1994) compared two approaches to reading comprehension strategies in children who had reading difficulties. The first approach was designed in terms of the scaffolding metaphor, while the second approach was a more didactic instructional reading condition. The didactic instructional approach used worksheets to teach strategies similar to those embodied in the scaffolding condition. Thus it might be said that one was a collaborative, and integrative strategy whilst the other was more “didactic confirmatory and factually-oriented”. Outcomes were measured both by how well students comprehended both the passages used during instruction and novel passages and also by measures of the students’ declarative knowledge of the strategies embodied in the interventions. Students in the scaffolded condition performed significantly better than their peers in the didactic instructional condition on all three measures.

Scaffolded instruction has also been shown to be effective in promoting positive outcomes in children with mild learning disabilities (U.S definition). Scruggs, Mastropieri and Wolfe (1995) examined the scientific preconceptions of 8-10 year-old students with mild learning disabilities and the extent to which their preconceptions changed when confronted by experimental evidence. Although such studies claim to subscribe to a socio-constructivist theoretical framework, the use of experimental

evidence such as weighing items on a scale to test out hypotheses is reminiscent of Piagetian designs, where the role of cognitive conflict is emphasised.

## **2.6 Overview**

In conclusion, it is fair to say that the majority of studies of collaboration in atypical learners do not seem to be set specifically within the theoretical accounts of either Piaget or Vygotsky as is the case in the mainstream literature. Instead, much of the available research focuses on outcome without placing the results within a theoretical framework. While some attention has been paid to socio-constructivist theories, there is a distinct lack of collaborative research in the Piagetian tradition in children with learning disabilities and the socio-cognitive conflict model is almost never employed.

When atypical learners have been included in collaborative studies, they have generally been paired with a TD child or an adult and on the whole little attention has been paid to the extent to which the atypical learner directs his or her own learning. Implicit within the design of such studies seems to be the assumption that atypical learners will best learn through a transmission process, that is, by being taught by a person who is more knowledgeable than they themselves are. It seems to be assumed that children with learning disabilities will be unlikely to benefit from a cognitive conflict situation, in which they are challenged to reflect on their own thinking. This is a curious assumption to make. If TD children at an equivalent developmental level, albeit at a younger chronological age, are able to benefit from working with a peer of the same



developmental level, why then should it be assumed that children with learning disabilities would not? The danger in this assumption is that children with learning disabilities are not challenged to change their cognitive structures, but may instead adopt the position of the more knowledgeable child without the underlying cognitive restructuring that is proposed to occur within the TD child. An additional concern stems from the fact that previous research has indicated that learning through imitation of a more advanced peer may not bring the associated cognitive changes that are seen in learning that arises as a result of socio-cognitive conflict. Such learning may therefore not be generalisable (Mugny & Doise, 1975, 1976).

Given that there has been little research on collaborative learning in children with learning disabilities in general, it is hardly surprising that little research has been undertaken on specific populations. Again this is possibly because the driving force behind research into collaborative learning in special populations is to achieve results while the relevance of findings to theories of cognitive and social development in special populations takes a back seat. When persons with DS have taken part in research into collaborative learning, they usually represent only a small part of a larger special population, thus making it difficult to draw any specific conclusions about how children with DS might behave in collaborative learning situations.

In sum then, the limited literature on collaboration in atypical learners suggests that there are potential benefits for both social and cognitive skills. However, there seems to

be a lack of research which considers the wider implications of collaboration for cognitive processes in children with learning disabilities. In cases where a transmission theory of learning is implicit, it cannot be determined whether the interaction has caused any change in terms of cognitive restructuring; advances may have come about simply through rote learning.

One of the reasons for the reliance on transmission methods of teaching and learning may be an underlying assumption that children with moderate to severe learning disabilities do not have the social and cognitive skills to regulate a productive interaction. In the absence of evidence in either direction, this is an assumption that clearly requires direct empirical investigation. The aim of the thesis is to investigate collaborative learning in children with Down syndrome. The next chapter will therefore outline the social interactive skills characteristic of children with Down syndrome and how these might be harnessed in collaborative learning contexts. It will also consider the specific learning problems commonly found in children with Down syndrome. Subsequent chapters present findings from a series of inter-linking studies of collaborative learning in children with Down syndrome, comparing their learning outcomes to those of children with non-specific learning disabilities (NSLD) and TD children.

# **CHAPTER 3**

## **COGNITIVE AND SOCIAL DEVELOPMENT IN DOWN SYNDROME**

### **3.1 Introduction**

Although research into the effects of collaboration in atypical learners is limited, the research that does exist suggests that peer tutoring and adult scaffolding can be beneficial, at least to the child with mild learning difficulties. As was stated in Chapter 1 and 2, at present there is no real evidence of the potential effect that collaboration could have on children with more severe learning disabilities and Piagetian frameworks of peer collaboration have not been considered at all in children with learning disabilities.

Down syndrome (DS) is the most common cause of moderate to severe learning disabilities. Although there is great variation in the level of competence achieved by individuals with the syndrome, they may be considered a homogenous group in terms of the aetiology of their learning disability. For this reason, persons with Down syndrome have often been included as a distinct group of participants in research studies. DS affects the individual in many ways; physiologically, neurologically and psychologically. Undoubtedly, the biggest problem for people with DS will be in learning. While it is widely accepted that the basis of DS and ultimately the learning difficulties seen in DS, is an overexpression of the genes on chromosome 21, this is not the only factor in the ultimate level of cognitive ability reached. Children with DS vary

as much in their cognitive ability as TD children do. While some are profoundly handicapped, some can learn to read (e.g. Buckley, 1985; Casey, Jones & Watkins, 1988; Lorenz, Sloper & Cunningham, 1985) and are educated in mainstream schools. It has been noted that cognitive competence in children with DS does not vary in accordance with the usual correlates such as parental IQ and socio-economic background (Carr, 1975). A longitudinal study by Carr (1988) indicates that the differences seen may, in fact, be a result of intervention on the part of those parents who are committed to ameliorating the intrinsic handicaps faced by children with DS as much as possible. There is, then, reason to suspect that children with DS may be heavily influenced in their learning by environmental effects. Further evidence for the effect of the environment on the cognitive development of children with DS comes from research which indicates that children with DS who were reared at home were more cognitively advanced than those reared in institutions (e.g. Carr, 1970; Shipe & Shotwell, 1965).

Evidence also exists to suggest that children with DS exhibit a particular behavioural phenotype with regard to learning. A behavioural phenotype is a set of characteristic behaviours which relate to a genetic disorder and which may be directly caused by the genetic make-up of the individual or which may arise as a consequence of interactions between that individual and the environment. This will be discussed in more detail later in this chapter. Some authors have proposed that children with DS may show different responses to socially mediated learning opportunities than children with similar levels of

learning disability of a different aetiology (e.g. Kasari et al., 1990; Kasari et al., 1994b; Landry & Chapieski, 1990). Again, this will be discussed later in the chapter.

The question that this thesis addresses then is how collaborative learning may potentially impact on the problem-solving skills of children with DS. This will be considered from an outcome-oriented viewpoint, i.e. can collaborative learning improve the learning outcomes of children with DS. In addition, this thesis aims also to assess how collaborative learning interacts with the approaches to problem solving that are characteristic of children with DS. In order to provide a background to the studies an outline of how DS arises is first provided, followed by a discussion of different theories of development in DS. Consideration will be given to the approaches to learning that are commonly associated with the syndrome before examining the characteristic social interactive skills of the person with DS.

### **3.2 Causes of Down syndrome**

The syndrome was first described by John Langdon Down (Down, 1866) who speculated that the physical characteristics seen in DS were a genetic recapitulation of the Mongolian race and hence introduced the term 'Mongolism'. This incorrect terminology was later replaced by 'Down's syndrome'. Latterly, the term 'Down syndrome' has become more common in international usage.

In 1959, Lejeune et al. and Jacobs et al. independently determined trisomy of the 21st chromosome to be the cause of the syndrome. It is still very much in debate why extra copies of the genes on Chromosome 21 lead to disrupted patterns of development. Reeves et al. (2001) note that two distinct schools of thought have emerged. Firstly, the 'developmental instability' hypothesis proposes that the correct balance of gene expression in regulating development is disrupted by the increased dosage of genes on chromosome 21 (Shapiro, 1997). This theory arose from the observation that the features seen in DS occur in other trisomies as well as in the general population in smaller frequencies. It has also been noted that the individual variability seen in persons with DS is much larger than that seen in persons with 46 chromosomes. The 'gene-dosage effects' hypothesis holds that the overdosage of a specific individual gene, or a small group of genes on chromosome 21 is responsible for the specific traits associated with the DS phenotype. Currently, the strengths and weaknesses of both theories are actively debated and Reeves et al. (2001) make the point that both theories are not necessarily exclusive.

Three main genotypes are recognised:

i) *Standard (full) trisomy 21*

Most people with DS (approximately 95%) have full trisomy 21 (Wisniewski et al., 1996) in which every cell in their body contains a whole extra chromosome. Trisomy 21 usually results from non-disjunction of the egg cell (Hassold & Sherman, 2000). More rarely, it can occur through non-disjunction during paternal meiosis.

## ii) *Translocation*

In about 4 per cent of cases the presence of an additional part, rather than the whole, of chromosome 21 causes DS. This is termed translocation DS and occurs when the small, top portions of chromosome 21 and another chromosome break off and the two remaining portions stick to one another at their exposed ends. Children with translocation DS are equally as affected as those with trisomy 21. In most cases, the translocation is an error that occurs in the formation of the sperm or the egg but in one-third of cases, one of the parents is found to be a carrier of DS. A translocation carrier is normal because he or she has the usual 23 pairs of chromosomes, but with one of the number 21 chromosomes joined to one of the other chromosomes.

## iii) *Mosaic forms*

In about 1 per cent of children with DS there is an extra whole chromosome in only a proportion of their body cells, the rest of the cells being normal. In such cases of mosaicism, the normal cells can have a counteracting effect so that the individual is sometimes, but not always less affected. He or she may have less prominent physical features and may function and develop closer to the normal range. In very rare cases individuals with this form will score within the normal range on intellectual development (Selikowitz, 1997).



### **3.3 Incidence and prevalence**

DS affects approximately one in 700 live births universally (Reeves et al., 2001). It was expected that advanced screening and diagnostic techniques would have decreased the incidence and hence the prevalence of DS over the years. In the U.K. pregnant women are routinely offered an alpha-fetoprotein (AFP) screening test, the results of which will determine whether a diagnostic test such as amniocentesis is necessary. When a foetus is shown to have DS the pregnancy is often terminated in the early stages. The cumulative effect of this is to decrease the number of babies born with DS. This has been attenuated, however, by increasing survival rates in infancy. Survival in the first year has shown particular improvements. Glasson et al. (2002) report that for recently born cohorts at least 90% will live to 1 year of age, while 85% will live to 10 years. Recent estimates have indicated mean survival of over 50 years for persons with DS (Friedman, 2001; Janicki et al. 1999). The prevalence of persons with DS in the community has also been affected by a considerable increase in life expectancy over time (Sadovnick & Baird, 1992). This increase may be partly due to advances in medical care (e.g. Cole et al., 1994, Fryers, 1986). It is apparent then that there will be a population of children and adults with DS in the community for the foreseeable future. An understanding of how the quality of life of those with the syndrome may be improved is therefore essential.

### **3.4 The physical effects of Down syndrome on the individual**

Trisomy 21 results in a constellation of more than 80 clinical traits, of which a sub-set will be observed in the individual with DS (Epstein et al., 1991). The features that are

present vary considerably in severity among individuals (Epstein et al., *ibid.*). Shapiro (1994) argues that those features which are most variable in the general population (such as cognitive ability) are probably those most affected by the presence of extra genetic material. It is not necessary for a whole additional chromosome 21 to be present to cause DS; all that is needed is a critical portion to be present to produce most of the effects seen in DS.

In terms of physical appearance, children with DS generally have certain characteristic features which are recognisable from birth and include: rounded face with flat profile, brachycephaly (flattening of the back of the head), upwards and outward slanted eyes, epicanthus (fold of skin between the inner corner of the eye and bridge of the nose), single palmar crease and short stature with relatively short upper arms. Infants often exhibit poor muscle tone, but this improves over time. The fact that DS is immediately recognisable, even to the lay person, has advantages in terms of early intervention and support. However, there may also be inherent disadvantages in terms of expectations of others. This is discussed in more detail later in the chapter.

Almost invariably, children with DS will have some degree of intellectual disability; unusually, for a major chromosomal disorder, the range of ability seen is wide – 50-60 IQ points (Carr, 1995). However, the majority of individuals fall within the moderate to severely handicapped range (Carr, 1985). Interestingly, the range of ability seen is not related to the usual correlates of intellectual ability such as parental IQ and socio-

economic status (Carr, 1975, 1992; Gibson, 1978). The chromosomal overexpression involved in DS does not always predict an extremely low ceiling, implying that environmental and psychological factors may have a crucial role to play. Again, this viewpoint will be discussed in greater depth below.

### **3.5 Theorising development in Down syndrome: The developmental-difference controversy**

The fact that DS is a genetic condition which is recognisable from birth has made it an interesting topic for developmental research. Research into DS has been carried out with the aim of not only understanding the condition itself, but also contributing to our knowledge of typical development. Over the past two decades or so, attempts have been made to conceptualise DS into a coherent developmental framework.

Traditionally, development in DS was argued in terms of the developmental-difference controversy. The basic question central to this debate was whether the development of children with DS could be described as akin to that seen in typical development, only at a slower rate and with a lower ceiling, or whether it could be described as differing from typical development in other ways. This debate originated from the similar-sequence, similar-structure theory advanced by Zigler and colleagues (Weisz, Yeates & Zigler, 1982; Zigler, 1969). This theory holds that people with learning disabilities pass through cognitive developmental stages in the same sequence as typically-developing (TD) children albeit with a lower ceiling and that development is consistent across domains.

In other words, a child with learning disabilities with a mental age of five should be at the same cognitive stage as the TD five-year old and should be at an equivalent level across different domains (e.g. language, cognition). There should be no obvious strengths or weaknesses in particular domains.

Despite the fact that Zigler intended the similar-sequence, similar-structure hypothesis to be applied only to those learning-disabled populations free from organic or genetic impairment, some researchers have argued that the development of children with DS is similar to that of TD children both in terms of the sequence and structure of cognitive processes (e.g. Cichetti & Pogge-Hesse, 1982; Cicchetti & Serafica, 1981; Lenneberg, 1967).

### **3.5.1 Evidence for the similar-sequence hypothesis**

Traditionally, children's development has been seen as comprising a number of discrete domains. For example, language and sensorimotor development are assumed to occur independently of each other. The similar-sequence hypothesis assumes that children with DS show the same developmental progression within each domain as TD children. There is evidence to suggest that development in children with DS does indeed follow the progression in developmental domains seen in TD children to some extent (e.g. Cicchetti & Beeghly, 1990; Cichetti & Sroufe, 1976, 1978; Cichetti & Mans-Wagener, 1987; Krakow & Kopp, 1983). This has led some to maintain that DS is simply a slowed-down version of typical development. However, there is also evidence of atypical sequence in some domains such as object permanence (Morss, 1983; Wishart, 1987).

There are also problems inherent in comparing the developmental sequences of atypical populations to 'typical' development, in that it is apparent that TD children also do not always exhibit sequential development. Hodapp (1998) notes that development in areas that appear to be most closely linked to biological domains (i.e. cognition and language) seem to be the most sequential. Less reliable sequences have been noted for competences in domains considered to be more social or cultural. Of course, from a Vygotskian perspective, cognition and language are inextricably linked to the social and cultural environment. Piaget (1932) also acknowledged the link between cognitive development and the social environment. Consequently, atypical developmental sequences could be as much a result of the environment as biological determinants, at least for older children.

While it has been proposed that TD infant behaviour may be biologically channelled (Scarr-Salapatek, 1975), later development may be much more dependent on the individual's environment. It has been noted that developmental *rates* in children with DS decline with age (e.g. Carr, 1985; Dicks-Mireaux, 1972; Duffy, 1990). There have been many explanations for this slowed-down rate of development ranging from neuropathology (e.g. Nadel, 1996), structural limitations in the brain (e.g. Kopp & McCall, 1982) to motivational deficits (Wishart, 1991). Whatever the explanation, this developmental trend is not reported in children with other types of learning disability. Whether it is biologically or socially determined, the fact remains that even if children

with DS show similar sequencing, the declining rate of development seen in these children is inarguably atypical.

### **3.5.2 Evidence for the similar-structure hypothesis**

While the evidence suggests that children with DS do, broadly speaking, follow the same developmental stages as TD children, the similar-structure hypothesis may be more of a challenge. Piaget originally proposed that a child who is at a specific stage for one type of cognitive functioning would be at a similar stage for all areas of cognition. The similar-structure hypothesis proposes that relations between domains in children with learning disabilities will correspond to those seen in TD children. There should, therefore, be no areas of either relative weakness or strength when compared to a mental age-matched TD child. Some authors have proposed that evidence exists in favour of typical relations between many domains such as play, affect and cognitive development (Cicchetti & Beeghly, 1990). Assessments of children with DS on the Kaufman Assessment Battery for Children (K-ABC; Kaufman & Kaufman, 1983) have also indicated that levels are reasonably even from one domain to another on major domains of the K-ABC (Hodapp et al., 1993; Pueschel et al., 1987).

However, the assumption that findings of no difference support the similar-structure position has been challenged (Spitz, 1983). When the profiles of two groups do not differ statistically in terms of test score, it cannot be assumed that their performances on the tests that comprise those profiles are the same (Weisz, Yeates, & Zigler, 1982). In fact, when more detailed analysis is made, children with DS do show relative strengths



and weaknesses in specific areas. Language is commonly identified as an area of relative weakness. Ability in grammar increases until a certain stage in development, whereupon it seems to increase only marginally thereafter (e.g. Fowler, 1988; Rondal et al., 1988). It is also commonly accepted that receptive language is superior to expressive language in children with DS and that the level of expressive language is generally below that of the overall mental age (e.g. Miller, 1989,1992). On the other hand some areas of social skills have been considered to be strengths, for example, non-verbal social interaction skills are noted to be a strength when compared with mental age-matched children (Mundy, et al., 1988).

### **3.5.3 Levels of analysis in the difference-delay controversy**

In some ways, conclusions contributing to the difference-delay controversy may be dependent on the level of analysis used: when compared with the overall performance of TD child on psychometric instruments, children with DS do, indeed, show 'delayed' performance (e.g. Dicks-Mireaux, 1972; Carr, 1975). However, when a less global level of analysis is used, it becomes apparent that there are population differences. For example, Krakow and Kopp (1983) propose that children with DS are remarkably similar to TD children in terms of attention to and engagement in play activities. However, they add "the current findings reveal that developmental similarity does not imply similarity in all aspects of functioning" (1983, p 1153) and note that for children with DS "attention is focused almost exclusively on toys to the relative exclusion of monitoring the greater environment or engaging the mother" (ibid., p.1149). Thus, while the play of the DS child appears similar to that of the TD child, it indicates perhaps a



different symbolic function, surely a significant difference in itself. In some ways, the roots of the 'developmental versus difference' controversy may be traced back to an over-emphasis on outcomes which pointed to an obvious delay while obscuring the atypical processes which contributed to the delay.

More qualitative studies reveal that features of cognitive development in the TD child do not necessarily hold true for the child with DS. For example, ability in the TD child follows a reliable pattern, both in terms of competences and errors, while competences are not just transitory one-off occurrences. In a series of studies on object concept development, Wishart (1988, 1993a) noted that the mean age of first success on the AAB task was not far off cross-sectional norms for age of acquisition of this stage in TD children. Despite this, a pattern of developmental instability was noted whereby children with DS often failed tasks that they had previously passed on more than one occasion. Wishart therefore argues that even when a child with DS has similar skills to a TD child, the route by which they reached that level of ability will be different.

Perhaps the debate might be better expressed not in terms of *whether* a difference exists but in terms of how different development is. If children with DS show similar coherency across domains but show different qualitative differences in *how* they reach their competencies, this may go some way towards explaining the declining rate of development seen in children with DS with age. While it is acceptable to propose that development in children with DS corresponds broadly to typical development with

regard to the sequence of development and relationships between some domains, it seems irrefutable that there exists a specific developmental profile particular to DS.

### **3.6 Behavioural phenotypes**

Another approach which has augmented understanding of DS is that of behavioural phenotypes. Originally a medical model, this approach has fallen into favour with psychologists, as it has become apparent that certain profiles and behavioural patterns are linked to specific genetic disorders. The term behavioural phenotype was introduced in 1972 by Nyhan to refer to behaviours which are an integral part of certain disorders and which may arise by biochemical, neurophysiological or other means. Harris (1987) proposed that behavioural phenotypes are the 'unlearned behaviour disorders'. Broadly speaking, research in this area attempts to link genes, brain and behaviour. The term 'behaviours' also encompasses complex higher order processes such as learning skills and intelligence (Plomin, 1990, 1991). At its inaugural meeting in 1990 the Society for the Study of Behavioural Phenotypes emphasised that, although some behavioural phenotypes seen in a specific group will have organic causes, others will not. This allows for the effects of both development and environment on behaviour. While DS may be thought of as a homogeneous condition, the range of outcome seen in persons with DS is vast, suggesting that environmental factors have an important role to play. Nadel notes that "the variability in this population...attests to the critical role of environmental (epigenetic) factors in determining the phenotype in Down's syndrome, given the uniform genotypic feature of trisomy 21" (Nadel, 1996, p.27).

Behavioural phenotypes were, in fact, used to describe children with DS as early as the 1860s through the work of Langdon Down. Down (1886) mentioned a generally amiable and humorous character and a great gift for imitation, as well as a marked stubbornness. In fact, the stereotype of the friendly, happy child who loves music has pervaded the lay person's view of DS (Gibson, 1978; Wishart & Johnston, 1990). Whether or not the stereotype has any accuracy remains to be seen, as it is only recently that investigation of within-syndrome characteristics has taken place. Whilst it is not possible to review the whole of the literature on the behavioural phenotype in DS (for review see Chapman & Hesketh, 2000) the most salient aspects will be briefly mentioned here.

Children with DS will usually have substantial learning difficulties and specific expressive language impairment (see Fowler, 1990). Some of the language difficulties seen in children with DS are thought to be related to an impaired auditory verbal short term memory (e.g. Chapman, 1995; Fowler, 1995). In adolescence, vocabulary comprehension is thought to be a relative strength (Rosin et al., 1988). Compared to children with other types of learning disabilities, children with DS show deficits in short term memory for verbal material but not for visual-spatial material (e.g. Jarrold, Baddeley & Phillips, 1999b, 2000; Laws, 1998). In terms of adaptive behaviour, parents of children with DS generally report less behavioural problems than parents with children with other types of learning disabilities (Stores et al., 1998).

Unlike the developmental approach to DS, which compares the developmental profile of children with DS to that of typical development, the behavioural phenotype approach is much more syndrome-specific. Its strength lies in the recognition that complex behaviours such as social interactions and approaches to learning may have a genetic basis, while still allowing for effects of the environment. In addition, while developmental approaches have tended to concentrate mainly on infants and children with DS, the behavioural phenotype approach has also addressed patterns of behaviours characteristic of adolescents and adults with DS, providing a more comprehensive overview of how DS affects the individual across his or her lifetime. On the negative side, although this approach recognises the role that genetics may play in complex interactive behaviours, it is still essentially an endogenous viewpoint that does not consider the individual child in context.

Taken together as a whole, the findings from research driven by the developmental-difference controversy and the behavioural phenotype approach have provided a comprehensive overview of the specific behaviours that relate to the DS genotype. In essence it is apparent that the development of children with DS may be termed 'delayed' at a global level. When more detailed investigation of the processes inherent in the acquisition of certain skills is carried out, it appears that development in DS is very different to that seen in developmentally age-matched children, in terms of cognitive processes and approaches to learning.

A complete overview of the DS profile is outwith the remit of this thesis and may be found in one of many general textbooks on DS (see e.g. Rondal, Perera & Nadel, 1999; Stratford & Gunn, 1996). The next section will consider three specific aspects of the DS phenotype that are particularly relevant to this thesis: language development, approaches to learning and social interaction. In some ways, this is an arbitrary split in the context of this thesis as these three areas will function interactively in any individual.

### **3.7 Language skills in individuals with Down syndrome**

The language skills of children with DS will affect both their ability to interact with other people, as well as their ability to extract information from a social learning format. Like many other areas of development in DS, it has been claimed that development of language in children with Down syndrome is a slowed-down version of that which occurs in typical development (Lenneberg, 1967). However, the conclusions from more detailed studies of children with DS as a distinct population, together with studies of language sub-domains within individuals with DS suggest that a specific behavioural phenotype exists for language.

There is considerable evidence to suggest that children with DS reach consistently lower levels of language skill than matched groups. When compared to groups of chronological age (CA) and mental age (MA) matched children with other types of learning disabilities, it has often been claimed that children with DS show the most severe language handicaps (e.g. Evans, 1977; Burr & Rohr, 1978). Research focusing exclusively on children with Down syndrome consistently reports a significant

discrepancy between language skills and mental age (MA) assessments (e.g. Thompson, 1963, Wisniewski et al., 1988). Overall, children with Down syndrome show deficits in expressive lexicon, syntax, and intelligibility compared to mental age-matched controls or their own comprehension performance, a pattern which has been proposed as phenotypic of the group (e.g. Chapman et al, 1998). They also show considerable variation in production skills (see Chapman, 1995; 1997a, 1997b for reviews).

### **3.7.1 Syntax**

While there is ample evidence to suggest that DS is characterised by a specific impairment within the language domain, this tells us little about the exact nature of any impairment. In order to do so, we must consider each language sub-domain separately. When language sub-domains are compared within individuals, it becomes apparent that a characteristic language profile exists within DS. One of the most striking features is the low syntactic levels reached by children with DS (e.g. Rondal, Lambert & Sohler, 1981; Wiegel-Crump, 1981). When compared to TD children of similar mental age, older children with DS typically produce shorter, less complex sentences with only limited use of grammatical devices (for reviews see Miller, 1987; Fowler, 1990). Jenkins (1993) matched children with DS aged 6 years, 6 months to 13 years, 6 months with TD children and children with other learning disabilities, and found that children with DS produced less mature language and fewer verbs than the TD children and produced fewer pronouns than both control groups. Similarly, Hesketh and Chapman (1998) found that adolescents with DS (mean age 15 years, 6 months) produced fewer verbs per utterance than TD children (mean age 3 years, 6 months) when matched for MLU.

Fowler states “the child with Down syndrome is not apt to move beyond the level of simple phrase structure grammar found in non-handicapped children younger than 3 years” (1990, p.308).

In contrast to TD children who begin to combine words once their vocabularies reach around 50 words, children with DS do not begin to combine words until their vocabularies have reached 100 words (Buckley, 1993). Despite this, the syntactic abilities of individuals with DS do appear to continue developing into early adulthood (Chapman et al., 1998).

### **3.7.2 Lexical knowledge**

In contrast to structural knowledge, lexical knowledge in children with DS appears to be relatively spared. First spoken words emerge at approximately the same mental ages as TD children (Cardoso-Martins et al., 1985). In studies of lexical knowledge, children with DS perform have been shown to perform at roughly the same levels as MA-matched TD children or children with learning disabilities (e.g. Bartel, Bryen, & Keehn, 1973; Lyle, 1960; Spreen, 1965). The disparity between lexical and syntactic development is also apparent when the domains are compared within individuals (e.g. Hartley, 1982; Ryan, 1975). Vocabularies increase with age, although more slowly than TD children (Hart, 1996). The vocabularies of children with DS appear to be in line with their MA particularly if both signs and spoken words are included (Caselli et al., 1998). There is also some evidence that vocabulary comprehension skills can exceed cognitive level in adolescence (Chapman et al., 1991). Harris et al. (1997) found that parents of



children with DS reported more use of gestures than parents of children with Williams syndrome matched for chronological age. It is likely that use of gestures in children with DS reflects their good visual-spatial short-term memory and poor auditory short-term memory.

### **3.7.3 Communicative skill**

Generally, children with DS exhibit communicative skills that are equal to, or often more advanced than the communicative behaviour of other learning-disabled groups matched for mean length of utterance (MLU) (e.g. Coggins, Carpenter, & Owings, 1983; Coggins & Stoel-Gammon, 1982; Owens & MacDonald, 1982). Studies of older children with DS also suggest that communicative skills may exceed verbal abilities (e.g. Nisbet, Zanella & Miller, 1984; Price-Williams & Sabsay, 1979). Also, when compared to TD children of similar language ability, the pragmatic skills of children with DS are fairly good. For example, Johnson and Stansfield (1997) reported similar pragmatic skills for children with DS and TD children matched for language comprehension age - in fact the children with DS were ahead of the TD children in some areas. Beeghly et al. (1990) compared the communication skills of children with DS aged 2 years, 6 months to 7 years, 9 months with TD children matched for MLU. The children with DS exhibited superior performance at maintaining conversations and turn-taking although there were no differences when compared to TD children of similar MAs.

### **3.7.4 Expressive language**

Studies of children with DS have consistently indicated problems in expressive language, greater than might be predicted on the basis of cognitive delay in non-verbal domains or comprehension skills (e.g. Andrews & Andrews, 1977; Cardoso-Martins et al., 1985; Dodd, 1975; Rosin et al, 1988). Emergence of multiword utterances occurs at mental ages similar to controls (Cardoso-Martins et al., 1985) but MLU in free-speech samples increases more slowly thereafter (Rondal et al., 1988). Miller (1988) reported 50% of his pre-school sample to show production-only deficits while 2 years later this had increased to 72% of the same sample. For older children deficits in expressive syntax in free speech samples have been reported (Rosin et al., 1988)

The poorer expressive skills of children with DS are compounded by their poor articulation which makes it difficult for others to understand them (e.g. Kumin, 1994; Stoel-Gammon, 1997). Kumin surveyed parental reports for 937 families and noted that 58% of parents reported that their children with DS “frequently” had difficulty being understood. Poor intelligibility may be aptly associated with hearing status (Chapman et al., 2000). The fact that intelligibility is a problem in children with DS might also affect the way that children with DS attempt to communicate. Chapman et al. (2000) proposed that children with DS might attempt to reduce sentence length and increase the number of utterances at the expense of syntactic comprehension and cohesion. However, no correlation between intelligibility and total utterances or MLU was found, suggesting that this is not the case.

### **3.7.5 Comprehension skills**

Despite the poor expressive language skills of children with DS their comprehension is better. Hasan and Messer (1997) found that the comprehension skills of 10 children with DS aged 1- 4 years exceeded their expressive language by 4-13 months. Similarly, Chapman and colleagues (e.g.1998; Chapman, Schwartz, & Kay-Raining Bird, 1991) found that vocabulary comprehension was better than syntax comprehension for a group of 47 children and adolescents age 5 -21 years. In addition, they found no difference between the vocabulary and syntactic comprehension of these children and a group of 2-6 year old TD children matched for MA.

### **3.7.6 Interaction between language and memory**

Impairments to short-term memory in individuals with DS are considered to be one of the causes of their inhibited language development. Some studies have shown that individuals with DS have poor verbal short-term memory relative to MA-matched controls (e.g. Bilovsky & Share, 1965; Rohr & Burr, 1978; Pueschel et al., 1987). It has also been suggested that short-term auditory memory is inferior to short-term memory for visuospatial information (e.g. Wang & Bellugi, 1994; Jarrold & Baddeley, 1997).

### **3.7.7 The role of language in collaborative interaction**

From this short review of the literature on language development in children with DS, it is apparent that the language skills of children with DS will have a large impact on how they function in collaborative learning situations. Firstly, the poor expressive language skills of children with DS will make it difficult for them to participate in task-related discussions. This will be further compounded by their poor articulation skills. In short, it

may be difficult for the collaborative partner to engage verbally with the partner with DS as it may take some considerable effort to decipher meaning. This may, however, be partially ameliorated by the preserved communicative skills of the child with DS, in terms of their ability to maintain conversations and participate in appropriate turn-taking. The poorer expressive skills of the child with DS may also be, in part, compensated for by the use of non-verbal communication. This may particularly be the case when the partner is a child with learning disabilities as certain systems for non-verbal communication are commonly found in special education schools. However, if considerable effort is needed to decipher the language of a partner with DS, there is the danger that the collaborative partner may choose not to expend the extra cognitive processing required and may instead simply choose to 'switch off'.

With regard to the comprehension skills of children with DS, it is apparent that children with DS may experience difficulty in understanding information which is presented verbally. For this reason, they may experience difficulty in utilising the verbal output of the partner to its fullest advantage. However, this again may be partly lessened by the interactive nature of the collaborative experience in that any verbal information given will be directly tied to the practical aspects of the task and will be highly contextualised.

### **3.8 Approaches to learning in Down syndrome**

As stated earlier in the chapter, development in DS was previously assumed by most researchers to be a slowed-down version of typical development. In terms of cognition this would indicate that children with DS would follow the same pathways of

development as TD children albeit taking longer at each stage and ultimately reaching a lower ceiling. When a child with DS and a TD child were at the same stage in development (regardless of chronological age) it was generally assumed that they had reached that stage by the same processes. While many still propose that cognition in DS is broadly similar to typical development in terms of sequence (e.g. Chapman, 2000), it is generally accepted that a distinct profile of approaches to learning exists which is characteristic of children with DS. Thus a child with DS may reach the same stage as a TD child, but the processes by which that stage is reached will be different.

Some of the cognitive problems seen in children with DS will, no doubt, be a result of neurological and physiological factors associated with the overexpression of genes associated with the syndrome. They will, for example, have to adopt a learning style to overcome their deficit in short-term memory for verbal material. On top of this, their cognitive problems may be further compounded by psychological factors that influence the particular approach to learning seen in many children with DS.

### **3.8.1 Declining developmental rates**

One of the most robust findings in DS research is that there is a decline in the rate of mental development with increasing age. IQ scores which can be near normal in infancy tend to decline steadily in the school years (e.g. Carr, 1988, 1994; Hodapp, Evans & Gray, 1999; Rynders, 1999; Wishart & Duffy 1990). By age 8, Gath and Gumley (1984) found a mean IQ of 45. This pattern is not seen in other learning-disabled populations,

for example in non-specific learning disabilities or autism (e.g. Sigman & Ruskin, 1999).

There has been considerable debate over what might cause this, and both genetic and environmental factors have been proposed (e.g. Nadel, 1996, 1986; Wishart, 1991, 1993b). It has also been suggested that individuals with DS have a particular learning style which prevents consolidation of existing skills and which is not conducive to learning new skills (see below). The net effect of this is that developmental age declines with chronological age.

### **3.8.2 Failure to consolidate learning and instability of achievements**

Two aspects of learning in children with DS which may actively contribute to declining developmental rates are a failure to stabilise acquired information (e.g. Fowler, 1988; Morss, 1983; Sloper, Glenn & Cunningham, 1986; Wishart, 1988, 1993b) and an instability between performance and competence (Wishart & Duffy, 1990).

Some studies have been able to show such differences in development in children with DS using Piagetian concept tasks. The Piagetian theoretical approach has been useful to DS research from the point of view that it emphasises mistakes as well as successes. Such an approach can differentiate between different approaches to learning and is important as children with learning disabilities may show different pathways to the same level of development as TD children. For example, Morss (1983) used object permanence tasks as the basis for a study that indicated that while children with DS are

delayed in achieving object permanence, this was not the only developmental difference. In TD children competences tend to be stable, that is once a certain level of skill is reached, that level is maintained. In contrast, Morss found that in the children with DS, successful achievement was reproduced in the following session just a little over half of the time suggesting that achievements may not always be consolidated. He also noted that while a clear developmental progression emerged within error types in TD children (from an uncorrected error, to a spontaneously corrected error) no such progression was noted in the infants with DS. The errors made by TD children may be thought of as conducive to developmental progress. Overall, the infants with DS conformed less than the TD children to predicted error patterns suggesting that cognitive development is more poorly organised in children with DS. The atypical pattern of errors seen in children with DS may therefore partly explain the instability of achievement seen. Morss (1985) suggests that children with DS need more exposure to material before they can learn spontaneously and that they seem to lack cognitive strategies of transfer.

In a series of longitudinal studies, Wishart examined the performance of children with DS on standard intelligence tests (Wishart, 1993a; Wishart & Duffy, 1990) and object concept tasks (Wishart, 1988, 1993a). Wishart and Duffy (1990) administered the Bayley scale of Mental Development to children with DS aged between 6 and 48 months on two occasions. Although there was no difference between the overall scores obtained by the children on the two occasions, performance on the items which made up the scores was erratic. Test-retest reliability was low, as successes gained on particular tests



would not reappear on re-tests as little as two weeks later. Similarly, while infants with DS were able to achieve success on object concept tasks at ages which were not that far off cross-sectional norms for the task, their performance on the task could not be considered to be typical. Participants who had succeeded on the task several times would go on to fail the same tasks at later stages in their development, a pattern not seen in TD children.

### **3.8.3 Diversionary and inappropriate strategy use**

On the object concept tasks Wishart (1993a, 1996) noted that failures on a task that had previously been passed were often the result of failure to engage with the task rather than an erroneous search. Participants would appear to engage in the task but use a very low-level or inappropriate strategy such as simply pointing to the same cup every time, giving a success rate of 50% at most. Once children had succeeded on a task there seemed to be no intrinsic motivation to practice that skill. Employing such strategies in an attempt to avoid engaging with a task which had previously been passed may be linked to later failure to consolidate learning. If children with DS do not exercise the opportunity to utilise newly gained information, this perhaps reduces opportunities to consolidate that information.

Wishart (1996; 1993b; 1991) noted that as well as failing tasks that had previously been passed with ease, children with DS went to considerable lengths to avoid tasks that were one stage ahead of their development. Failures on tasks that had previously been passed were usually a result of a return to a low-level strategy whereas failures on more difficult

tasks were usually the result of a failure to engage in the task (1988, 1993). The participants avoided engaging with the task through a variety of means such as simply sweeping the experimental materials to the floor or employing social strategies to divert the experimenter's attention away from the task. Such 'social' strategies included locking eye contact, smiling or producing 'party pieces'. Pitcairn and Wishart (1994) reported that when faced with an impossible task, children with DS displayed more diversionary behaviour than did TD children. Tellingly, these kinds of behaviours were not produced when the child was asked to do an easier task; during these tasks they remained focused. It appears then, that social behaviours may sometimes be used to distract the attention of a learning partner when the child is challenged by a new task or situation and therefore may be considered an inappropriate, rather than an appropriate, social response.

Wishart (1987) makes the point that it is often difficult to discern between 'can't do' and 'won't do' behaviours in children with DS. Failures in TD children usually denote the upper limits of the child's ability; in children with DS the same cannot be assumed. They seem reluctant to engage in tasks that present a challenge. Thus children with DS seem to want to avoid cognitive challenge, but at the same time become quickly bored with a task once they have succeeded a few times. If children with DS show such reluctance to practice existing skills and avoid opportunities to challenge themselves it is perhaps not surprising that developmental rate declines with age.

### **3.8.4 Differences in motivation to learn**

Active avoidance strategies deployed in challenging situations suggest that poor motivation may be a factor in depressing the performance of children with DS. There is indeed some evidence to suggest that children with DS may show different motivational patterns from infancy onwards.

In a series of operant learning studies Wishart and colleagues (Wishart, 1991, 1993a; Wishart & Duffy, 1990) provided evidence that young children with DS may have a reduced drive to control the environment. Infants with DS were placed in one of two conditions: contingent sessions where the child's kicking controlled the movement of a mobile and in mixed contingent/non-contingent sessions in which the child could still control the mobile, but it would turn randomly by itself 10% of the time. In the sessions where the mobile rotated by itself, the children were content to wait for the mobile to move, despite understanding that the mobile could be moved by kicking. Thus their interest in the task was satisfied as much by passive acceptance of the 'free' rotations as by any active participation in the task.

Hasan and Messer (1997) also favour a motivational explanation for their failure to replicate Wishart and Duffy's (1990) object concept findings. Hasan and Messer tested children with Down syndrome aged 15 to 45 months on object permanence tasks. These children, who were tested monthly, all succeeded at the same or more advanced tasks with each successive visit. None of the children showed regressions as they had in the Wishart and Duffy study. Hasan and Messer explain the difference in findings between

the two studies as being due to the fact that they visited the children in their own home and varied administration of the task according to the child's level of interest. They argue that this more child-led approach motivated the children to respond.

A child's motivation to be effective and gain competence in dealing with their environment is described as mastery motivation (White, 1959). Mastery motivation is manifest in object exploration and engagement in goal directed behaviour. There is substantial evidence to indicate that children with DS will perform differently to control children on various aspects of mastery tasks. Studies have shown, for example, that children with DS will spend longer simply looking at objects and less time actually engaged in mastery behaviours such as exploration than do TD matched controls (MacTurk et al., 1985; Vietze et al., 1983). Differences in the quality of object exploration have also been demonstrated (e.g. Berry, Gunn & Andrews, 1984; Krakow & Kopp, 1983; Landry & Chapieski, 1990). In accordance with Wishart's studies, Dayus (1999) found that infants with DS tended to show less mastery, and more non-task and social behaviours than TD infants. This finding was corroborated by data collected via parental questionnaires. Dayus noted that children with DS were more motivated from an early stage by toys providing immediate feedback than toys which required more manipulation, suggesting that low mastery motivation may be an intrinsic feature. However, she also noted that parents of infants with DS tended to be more directive and a negative relationship was identified between infant mastery and parental dominance at

6, 12 and 24 months. This seems to suggest that environmental factors also play a determining role in motivational levels in children with DS.

Dayus' findings are consistent with those of Ruskin et al. (1994a) who suggested that children with DS are generally less motivated to play than developmental age-matched TD children. Ruskin and colleagues demonstrated what different toys did to DS and TD children and found that although both groups of children explored the toys to the same extent, the children with DS produced shorter sequences of behaviour with the toys and appeared to gain less pleasure from playing with them.

Reduced levels of mastery motivation may result in the use of superficial strategies for learning as the child is not motivated by solving the problem in itself, but is likely to be more motivated by external factors such as gaining approval. Wright (1998) found evidence to suggest that children with DS may be using fairly low-level strategies when succeeding on conceptual tasks. Children with DS in this study had previously performed well on an object concept task. However when they were prevented from using imitation as a strategy, success rates fell. When the same experiments were performed with TD children, success rates remained stable. Wright suggested that the success seen in the children with DS was tied to copying the action of the experimenter rather than to developing representations of the hidden object, as is normally assumed. He concluded that children with DS might thus be motivationally, or attentionally, predisposed to imitate in comparison to TD children.

An apparent preference for 'imitative representation' in children with DS would imply a lower level of engagement with other, non-imitative aspects of the task. This lack of deductive reasoning will of course have later implications: such learning will not serve well as a building block for future learning, neither will it generalise to different situations. Thus reduced mastery motivation in children with DS may be linked to the decline in developmental rates of the child with DS.

Poor motivation may be related to the learning environment of the child with DS. This is likely to differ to that of the TD child in terms of both the nature and length of learning histories. Progress is likely to take longer in the child with DS and failure is likely to occur more often. Wishart provides evidence to suggest that children with DS may become increasingly reluctant learners as experience of learning failure lengthens (Wishart, 1991, 1993a, 1996).

A history of failure in independent problem-solving is hypothesised to be strongly related to levels of outer-directedness (Turnure & Zigler, 1964). Outer-directedness is the term used to describe an over-reliance on external cues rather than on internal cognitive abilities in problem-solving situations (Yando & Zigler, 1971). It has been suggested that outer-directedness may be measured by the number of glances towards another during problem-solving (Bybee & Zigler, 1998). Linn, Goodamn and Lender (2000) noted that when left to play alone with toys, children with DS initiated twice as

many episodes of interaction with adults than developmental age-matched TD children. This seems to suggest that children with DS may use a more outer-directed approach.

In addition to the problem-solving approaches of children with DS being affected by their own learning histories, expectations of children with DS by others may be generally low. DS is a disorder which is recognisable immediately from birth. Although early diagnosis has many positive benefits, there are also associated drawbacks. DS is almost always accompanied by a significant degree of learning disability and parents may have low expectations of their child's cognitive progress from the outset (Krasner, 1985). This is often not the case for individuals with non-specific learning disabilities; diagnosis may not come until years later and many children do not have the physical characteristics that inform others that they have learning disabilities. Individuals with non-specific learning disabilities are likely to be assumed to be 'capable until proven otherwise'. In the case of DS, however, it may be likely that low expectations will, to some extent, become self-fulfilling.

### **3.8.5 Summary of the literature on approaches to learning in Down syndrome**

Declining rates of development is a feature of children with DS that is not associated with either TD children or children with other types of learning disabilities. This may be partly an epiphenomenon of the brain structural changes seen in DS. However, it is also possible that the declining rates are contributed to by the counterproductive approaches to learning often seen in children with DS. The sum of the literature suggests a picture of child who is 'cognitively lazy'. Examples of this are a reluctance to practise existing



skills, the use of diversionary strategies to avoid cognitive challenges and the use of very low-level strategies requiring little cognitive effort in problem-solving situations. In addition, there is a suggestion that children with DS may not have the same intrinsic motivation as other groups of children to master tasks. Instead they may be dependent upon extrinsic rewards such as the approval of others. Reduced levels of mastery motivation will possibly result in individuals resorting to a rather superficial approach to learning where the motivation is not to understand how something works, rather it is to gain approval or alternatively to get the task over as quickly as possible. Such an approach to learning might prevent consolidation of information and prevent generalisation to other problem-solving situations.

In the next section we will now consider children with DS in interaction with adults and other children in order to set the scene for discussing how socially-mediated problem-solving situations may affect the cognitive outcomes of children with DS.

### **3.9 Social interaction in children with Down syndrome**

#### **3.9.1 Social interaction in infants with Down syndrome**

It has long been recognised that interactions between infants and their caregivers may be the building blocks for later development (Trevvarthen, 1974, 1977). In particular, the importance of reciprocity and temporal synchronicity in mother-infant interaction has been emphasised (e.g. Bateson, 1975; Brazelton, et al., 1974). There is some evidence to suggest that infants with DS and their mothers may show atypical patterns of development from an early period.

Jones (1980) found higher proportions of communicative clashes and of maternal directive behaviours during interactions between infants with DS and their mothers when compared with developmentally-matched TD children. Berger and Cunningham (1983) also noted that mothers and infants with DS become less successful over time at mutually adapting and regulating their vocal behaviour than dyads of TD children and their mothers. There is less conversational turn-taking and mothers appear more directive and restrictive, with the mother often initiating the action (e.g. Chapman, 1995; Gunn, 1985a; Snow, 1995). Such maternal directiveness reduces opportunities for the child to exert agency.

The lack of contingency seen in interactions between parents and their infants with DS may be due to impairments in the infant's signalling behaviour, the parents' reactions to the child with DS or an interaction of both factors. There is evidence to suggest that factors intrinsic to the child with DS may make interaction more difficult to initiate and maintain for the parent. This may be evident in many modalities. For example, early evidence shows that the vocal behaviours of children with DS differ in quality and quantity from those seen in TD children (e.g. Lenneberg, 1967) and that smiling and eye contact are slower to develop (Berger & Cunningham, 1981; Cicchetti & Sroufe, 1978). Studies have shown that even familiar adults may have difficulty in interpreting the facial expressions of children with DS (e.g. Berger & Cunningham, 1981). Another major problem is the recurrent hearing problems commonly found in children with DS

which may cause low levels of verbal imitation in comparison with TD children (Chapman, 1995).

It may be the case though that the atypical interactions seen between parents and children of DS are adaptive rather than maladaptive. Some argue that directive interaction is appropriate for children with DS and is therefore facilitatory (Lieven, 1994). There is evidence to suggest that children with DS may have difficulty in responding to subtle behaviours. Jones (1980), for example, noted that infants with DS failed to respond to maternal cues easily picked up by TD children at similar developmental ages. Only when the mothers modified their cues, presumably to make them clearer, did the children respond. In a similar vein, Yoder et al. (1996) demonstrated that while mothers of children with DS expand their child's utterances to a remarkably similar degree to mothers of children with other types of language delay, they tended to expand different *types* of utterances. Specifically, they were more likely to expand partially intelligible multi-word utterances than to expand fully intelligible multi-word utterances. This may occur because of differences in the speech and language patterns of children with DS. Children with DS produce utterances that are shorter and less intelligible than other learning-disabled children who have been matched for general language level (Rosin et al., 1988). Parents of children with DS may therefore expand different utterances than parents of children with other types of language delay because the child's less intelligible and shorter utterances mean that more work has to be done to co-construct the message.

While the atypical patterns seen in parental interactions in children with DS may be due to the parent's attempts to adapt contingently to the child's patterns, it is difficult to disentangle whether parental reactions to the child with DS are an accurate reflection of the child's abilities, or whether they are a reaction to the child's *perceived* ability. An interesting study by Krasner (1985) indicates that mothers may indeed have lowered expectations of children with DS. Mothers were asked to play separately with 4-year old TD twins but were told that one of the non-identical twins had DS. The mothers subsequently used more commands, fewer complex questions and ignored many of the child's attempts to start up a conversation when interacting with the child who supposedly had DS. This suggests that while there may be features of the child with DS that make interaction problematic, at least some of the disruption found in the interactions of mothers and infants with DS may be due to the expectations of the caregiver. A very directive approach may therefore be a result of mothers feeling that their child requires extra intervention and that they must turn every interaction into a teaching moment instead of just playing (Jones, 1980).

Whether or not the interactional patterns commonly seen between parents and their children with DS can be considered adaptive or not remains to be seen. What is clear is that children with DS are engaged in social interaction of a different nature to that seen in TD children from an early age. Without doubt these differences stem from the presence of DS whether directly through features that are intrinsic to the syndrome or indirectly through parents' expectations of their child with DS. As child-parent

interaction is proposed to be a cornerstone of later cognitive development it is possible that atypical social interaction may pave the way for later differences in cognitive development and approaches to learning.

### **3.9.2 Interaction in older children with Down syndrome**

In view of the atypical infant-parent interactions reviewed above, it would not seem surprising if children with DS were perceived as being difficult to interact with. While the stereotype that children with DS are very sociable and affectionate abounds, the research into personality and affective behaviour in DS does not provide much support for this view (e.g. Berger & Cunningham, 1983; Gunn & Berry, 1985a, 1985b). Studies of temperament have shown that there is no support for a stereotyped personality of DS, instead the range of personality characteristics is just as broad as it is in TD children (e.g. Berger & Cunningham, 1983; Gunn & Berry, 1985a, 1985b). Empirical research has also yielded mixed findings regarding their level of sociability (Serafica, 1990).

There is also evidence to suggest that children with DS may have difficulties in recognising emotions when compared with developmental age-matched TD children (Kasari, Freeman & Hughes, 2001; Pitcairn & Wishart, 2000). Despite this, when compared to children with other types of learning disabilities, children with DS may indeed have advantages in some aspects of social behaviour. A study by Gibbs and Thorpe (1983) suggests that children with DS may be more sociable than children with other types of learning disabilities. Children with DS are indeed often reported as being pleasant and cheerful (e.g. Capps et al., 1993; Hornby, 1995).

### **3.9.3 The sociability of children with Down syndrome in relation to peers**

While interactions between caregivers and young children are thought to be crucial for later development, Chapter 1 highlighted the significance that some theorists also place on the role of peer interaction in cognitive development (e.g. Piaget, 1932). Generally, the findings regarding the sociability of children with DS towards peers are mixed.

Schlottman and Anderson (1975) looked at dyads of children with DS and non-specific learning disabilities and found that boys with DS smiled significantly more than boys without DS, and exhibited less solitary toy play. However, this was apparent only in same sex male dyads. Girls with DS were found to be more likely to reject overtures from others. Generally, Schlottman and Anderson noted that children with DS are not more sociable than children with other types of learning disabilities and hypothesised that sociability may vary as a function of familiarity with the other person.

Similarly, Sigman and Ruskin (1999) looked at the peer interactions of three groups of learning-disabled children: children with autism, children with DS and children with non-specific learning disabilities. Specifically, they considered whether children with DS are especially social when interacting with peers. A number of differences were noted but these were not, perhaps, what would be expected. While children with other types of learning disabilities favoured high level social play, children with DS were as likely to be isolated from others as they were to be engaged with their peers. In addition, children with DS were no more likely to initiate social interactions than the children with non-specific learning disabilities. They also found that children with DS, children with autism and children with non-specific learning disabilities did not show any

differences in terms of maintaining an interaction after initiation. Interestingly, although children with DS did not distinguish themselves with a higher proportion of social play, they seemed more able to form friendships than the other children. This concurs with Carr's (1995) finding that two-thirds of 11 to 21 year-olds with DS had at least one friend. In conclusion, while children with DS do not distinguish themselves in terms of initiating contact or in levels of play they may be better adapted to forming friendships.

#### **3.9.4 Peer interaction with typically-developing children versus children with other learning disabilities**

In relation to this thesis, it is of interest whether children with DS find it easier to interact with TD children or children with other learning disabilities. Studies carried out in the 1980s showed that children with mild learning disabilities tend to be more involved in peer exchanges when they were placed in integrated versus specialised settings (Strain 1984). In addition, the quality and frequency of positive social exchanges improved when they played with TD children of the same chronological age (Guralnick and Groom, 1987). The authors proposed that this finding might be due to the organising role of the TD children. However, this finding may not extend to children with DS, who are likely to have more serious learning disabilities. Sigman and Ruskin (1999), for example, found no evidence that levels of peer engagement varied as a function of access to TD children for the children with DS in their study.

Some studies have shown that children with DS may actually have more difficulty in interacting with TD peers than they do with adults. In a study of pre-school age children,



Sinson and Wetherick (1981) demonstrated that children with DS, who appeared to be socially accepted within their playgroup, nevertheless engaged in no verbal interaction with their TD peers and spent relatively little time in constructive behaviour. The majority of their social interaction was with adults and, in fact, they spent much of their time when around peers engaged in inappropriate or non-constructive behaviours. In contrast, in a nursery for children with learning disabilities, children with DS engaged in constructive and imaginative play. Longitudinal studies over two years showed that children with DS who remained in normal playgroups became social isolates and had interaction only with adult helpers.

While access to TD peers may facilitate social interaction in children with mild learning disabilities, the differing interactional style seen in children with DS may make interactions with TD children difficult to sustain. One problem that has been identified is gaze. It is widely accepted that mutual gaze is a precursor to play interactions (Argyle & Cook, 1976). Sinson and Wetherick (1981) noted that children with DS established eye-contact with other learning-disabled children in a nursery for learning-disabled children only, but did not do so with TD children when introduced into a normal playground, although they were able to make normal eye contact with adults in the playground. Additionally, they noted that when TD children tried to make eye contact with the children with DS, this was usually unsuccessful.

While this study suggests that children with DS may not react appropriately to social overtures, there is also evidence to suggest that TD children will react differentially to a child with DS. Sinson and Wetherick (1982) demonstrated that the arrival of a child with DS into a group of TD children was followed usually by a period of intense scrutiny before the TD children retreated, leaving the child with DS in isolation. This finding was robust whether it was an infant or child with DS and regardless of sex. In contrast, TD children were integrated into the group immediately. When the TD children were requested to play with the child with DS, they did so without mutual gaze occurring. Sinson and Wetherick concluded from this that mutual gaze rules might govern the success of interactions between unfamiliar children and that the atypical gaze patterns seen between the children with DS and the TD children may have been a barrier to interaction.

It has also been suggested the children with DS might be avoided as social partners by TD children due to their language difficulties. The expressive language of children with DS is characterised by poor articulation which often make it difficult for others to understand what they are saying (Kumin, 1994). However, Coggins, et al.(1983) demonstrated no significant difference in various communicative intentional behaviours directed towards mothers by a group of children with DS and a group of TD pre-schoolers matched for cognitive level and linguistic abilities. This implies that young children with DS can be as flexible and diverse in their use of language during social interaction as are children who are TD. Thus while children with DS may indeed have

expressive language difficulties, they may be flexible enough that it does not affect everyday social interaction with caregivers.

There is also little to suggest that the poorer expressive language skills of children with DS affect interactions with peers greatly. Laws et al. (1996) found no correlation between the language skills and popularity of a group of 8 to 11-year-olds with DS, as rated by their mainstream classroom peers. Similarly, Sigman and Ruskin (1999) found that mental age and language age were significantly related to high level social play for children with autism and developmental delays but not for the children with DS in their study. As children with more adequate mental ability and language should be better able to maintain social exchange this perhaps implies that children with DS are able to compensate for their poorer verbal ability, perhaps through non-verbal means. This interpretation is in line with Franco and Wishart's (1995) finding that pre-school children with DS show a higher level of gesture production and visual checking than mental age-matched TD children. While these studies indicate that children with DS are able to use the language abilities available to them effectively, especially in interactions with adults, their poorer verbal skills may nevertheless be a social barrier when interacting with TD peers.

There is some evidence to suggest that given the choice, children with DS choose other children with learning disabilities as playmates over typically developing children.

Rogers-Warren (1980; cited in Serafica, 1990) showed that when children with DS were

in a setting with both TD and learning-disabled children, they interacted more with the learning-disabled peers. Thus children seem to actively pick out members of their respective 'groups' as playmates. This is similar to Sinson and Wetherick's (1981) finding that pre-school children with DS were able to establish eye-contact with other learning-disabled children in a setting for learning-disabled only children, whereas children with DS in an integrated nursery were unable to establish eye contact with their TD peers. This may be partly due to experience as children with learning disabilities who have limited experience of interacting with TD children may find it easier to interact with other children with learning disabilities. Equally, it could be a reaction to the TD children's reactions to the child with DS.

The findings from research on school-age children with learning disabilities are mixed. Following a meta-analysis of 19 studies Weiner (1987) concluded that the majority of studies indicate that children with learning disabilities are less accepted in mainstream classrooms. However, Laws et al. (1996) found that the majority of children with DS in their study enjoyed average levels of acceptance within a mainstream classroom.

If children with DS are not readily accepted into a mainstream environment this could reduce opportunities for constructive interactions and perhaps have implications for certain areas of development. Freeman and Kasari (2002) for example, noted that children with DS who were educated in mainstream schools were rated as less cohesive and less co-ordinated in their play than children with DS who were educated in special

settings. The children who were educated in mainstream schools also spent more time in lower levels of play (solitary, parallel or parallel aware), whereas those from special settings spent more time in a higher level of play (simple social play). Thus reduced opportunities to interact with peers may also reduce opportunities to be involved in co-operative play situations.

### **3.9.5 Attentional processes during social situations**

Another area where children with DS may differ from TD children is in attention deployment during social situations. There is ample evidence to suggest there is deviation in general attentional development in young children with DS. Children with DS tend to look for longer periods to both inanimate objects and to social interactants than TD children of a similar developmental level (e.g. Cicchetti & Ganiban, 1990; MacTurk et al., 1985; Landry & Chapieski, 1989; 1990).

It has also been shown though, that children with DS also have a particular attentional style, in that they are more socially-focused than TD children or children with other types of learning disabilities. In situations where social interaction is the main focus, children with DS have been shown to be more attentive to the caregiver and less attentive to objects in the environment than chronological age-matched TD children (e.g. Berger & Cunningham, 1981; Gunn et al, 1982). Kasari et al., (1990) found a similar result with mental age-matched children. In this study, children with DS spent more time looking at the experimenter's face and less time looking at toys that were visible but out of reach than did the TD children. Similarly, Kasari, Mundy, and Sigman (1995)

observed that 1-3 year old children with DS looked more to adults providing an affective message than to a visually-active toy than did mental age-matched control children.

In social situations, this extreme focus on people could be beneficial in terms of keeping the child focused on the task. However, in situations where attention needs to be spread between objects and people it could actually be counterproductive. For example, Landry and Chapieski (1990) demonstrated that children with DS were less likely than mental age-matched pre-term children to benefit from a joint attention condition in which the mother tried to encourage the child to engage with a toy. The children with DS typically focused more on the mothers to the neglect of the toy. A willingness to explore the environment is generally thought to be implicated in cognitive ability and atypical attention deployment has indeed been linked to later cognitive competence in children with DS (e.g. Gunn, Berry, & Andrews, 1982; Jones, 1980; Krakow & Kopp, 1983). A greater interest in social interaction may also result in less task persistence. Ruskin, Kasari, Mundy and Sigman (1994a), for example, found that children with DS engaged in fewer strings of task persistent behaviour during toy exploration than developmental age-matched TD children.

As already noted, children with DS gaze longer at both objects and people than do control children (e.g. Berger & Cunningham, 1981; Miranda & Fantz, 1973). This seems to suggest that children with DS show difficulty in switching attention between different objects or from objects to people and vice versa. For example, Krakow and Kopp (1983)

found that in play with objects, children with DS tended to focus almost exclusively on the toy they were playing with and rarely shifted their gaze to other objects. TD control children frequently shifted their attention. Taken as a whole the evidence suggests that children with DS may not be able to make the most of available information in the environment, for example, through social referencing or exploration, and that this may compound their learning difficulties. There are also implications to be drawn for collaboration. If children with DS find it difficult to switch attention between people and objects, they may not be able to use their partner as an effective source of information.

Ruskin and colleagues (1994b) set out to determine whether the more focused style of children with DS is a general attention deficit or whether it is limited to social situations by comparing the attention children with DS paid to the tester in separate object and social mastery tasks. They found that the pre-school age children in their study did not show a more focused attentional style than mental age-matched TD children in the object mastery task, but did so in the social mastery task. This finding seems to concur with the findings of Landry and Chapieski (1990), suggesting that children with DS do indeed have a socially-focused attentional bias. This trend continues into school age (Kasari & Freeman, 2001) and may include object mastery task with peer partners.

Schlottman and Anderson (1975) report that children with DS obtained higher scores on socially-mediated object manipulation than children with other learning disabilities. They were more likely to manipulate or inspect a toy in co-operation with another child



and were engaged in significantly more social play, that is, playing with an object whilst involving another person.

Two interpretations could be drawn from this: Ruskin et al. (1994b) suggest that material should be presented to children with DS in a social format as it is more likely to attract and maintain their attention than material presented in a more passive form. This would imply that collaboration is the ideal format for learning as material is presented in a lively social format. On the other hand, the fact that children with DS have a tendency to attend to social aspects of a situation may mean that they attend less to the task than they do to the person present. Thus the presence of a partner may actually be a distracting factor when other information is available in the environment.

### **3.9.6 Summary of the literature on social interaction in Down syndrome**

It is apparent that children with DS show atypical patterns of interaction from birth. Whether these are a result of factors intrinsic to the child or the consequences of the particular style adopted by parents remains to be seen. The more directive style seen in parents of children with DS is generally associated with poorer outcomes in TD children as it allows the child less opportunity to show agency and take part in controlling the interaction. While children with DS seem to have a more socially-focused attentional style, it is doubtful whether this confers any advantage in terms of social referencing skills. Ruskin and colleagues (1994a, 1994b) do provide evidence that children with DS may focus on tasks better in a social situation, but on the other hand, children with DS

may tend to focus on social aspects while ignoring other available information (Kasari, Freeman, Mundy & Sigman, 1995).

In the area of peer interaction in DS, a tendency to concentrate on examining whether children with DS are more social than other children with learning disabilities has meant that more interesting aspects of peer interactions have been overlooked. The available research has not shown any real support for the notion that children with DS are more sociable than children with other types of learning disabilities, but there is evidence to suggest perhaps that interactions within groups of learning-disabled children may be easier than between groups of TD and learning-disabled children. Although the studies mentioned suggest that differences in mutual gaze may affect the amount of interaction between children with DS and their TD peers, it is unclear whether these patterns stem from inherent problems or whether they could be overcome by prolonged contact. Whatever the cause, problems with eye contact may lead to reduced opportunities to engage in social play between children with learning disabilities and TD children. This is interesting given that the issue of how early peer interaction might affect later learning in children with learning disabilities has not been fully addressed, despite the extensive attention it has received in the literature on typical development.

### **3.10 Implications for collaborative research in children with Down syndrome**

From the literature reviewed in this, and the previous two chapters, several conclusions may be drawn that are relevant to the main focus of this thesis. This chapter has briefly reviewed developmental accounts of DS which stress the need for fine-grained analysis of the developmental processes noted in children with DS rather than focusing on more global measures of development only. Such fine-grained analysis has revealed that children with DS show profiles of behaviours that are very different to those seen in either TD children or children with other types of learning disabilities. This is particularly marked in relation to the way in which children with DS approach new learning. Given this major difference, it would be wrong to simply assume that the results from studies of collaborative learning in TD children will also apply to children with DS. Nor would it be appropriate to assume that the outcomes seen in collaborative situations for children who exhibit other types of problems in learning will be the same for children with DS. Moreover, the literature concerning children who experience problems in learning has tended to focus on the outcomes of collaborative learning situations without analysing the processes leading to those outcomes. All these factors highlight the need for research which examines collaborative learning in children with DS, taking into account the particular profiles of behaviour commonly associated with DS, whilst simultaneously locating the results within the existing theoretical frameworks of collaborative learning in TD children.

Chapter 2 indicated that the limited amount of research into collaboration in children with learning disabilities has focused mainly on the outcomes in terms of achievement or acquisition of social skills. This lack of a theoretical framework tends to produce results that are then interpreted in a rather ad hoc fashion. If collaborative learning produces gains, we cannot be sure why. If it does not, we are no further forward, as it is always possible that it did not work because the methods used were wholly inappropriate for children with learning disabilities. As Wishart (1993a) notes, the 'developmental rate [of children with DS] may not be responding to current educational input because that input is in some way inappropriate in its structure, in its timing, or at an even more basic level, in its theoretical underpinnings' (p.391).

As we have seen, children with DS may follow different developmental pathways from TD children. These differences must be taken into account when considering any effects of collaboration. Dialogue is known to be a pivotal factor in the success of collaborative interactions. Children with DS may be somewhat disadvantaged in this respect, in view of their language difficulties, in particular the problems they experience in comprehension. Their ability to function as a competent partner may also be affected by difficulties in expressive language and articulation.

From the section in this chapter on social interaction it appears that children with DS may be more focused in problem-solving situations where an adult is present. This has led some to suggest that socially-mediated problem-solving situations may be an

excellent learning forum for children with DS. On the other hand, it has been posited that the intense attention that children with DS pay to an adult partner may distract the child away from relevant features of the task or the environment and may actually be detrimental to learning.

Even less is known about the effect of a peer partner on collaborative situations involving children with DS. While Vygotskian accounts might suggest that TD children or more competent learning-disabled children would be the best collaborative partner for children with learning disabilities, Piagetian-type accounts would maintain that the best partner would be of equal ability and status. From this viewpoint the ideal partner would be a child with learning disabilities of a similar ability level. Collaborations between TD children and children with learning disabilities would not be thought to be productive due to the asymmetry in power. In some ways, a child with learning disabilities may afford a similar-age TD child the same power as he or she would an adult.

Little is known, in theoretical terms, about how dyads of children involving at least one child with learning disabilities might perform in collaborative settings. However, there is research to suggest that children with learning disabilities may find it easier to interact with other children with learning disabilities, rather than TD children. Research has shown that when faced with a challenge, children with DS will play up to an adult in an attempt to distract their attention away from the task. It will be interesting therefore to

explore whether this behaviour is either exacerbated or curtailed when a child is the learning partner.

In Chapter 1 it was proposed that active participation is an important component of successful collaborative learning situations. It has also been suggested that the presence of a partner may keep the child with DS focused. However, this may only apply to adults who tend to scaffold child partners. In peer collaboration contexts, the reduced mastery motivation of children with DS and their tendency to relinquish control over tasks may mean that they are happy to take on a passive role and leave most of the work to their partner.

Some of these issues will be explored in the next chapter, others in subsequent chapters. The next chapter describes Study 1 in this thesis: an exploratory study of the behaviours and learning outcomes for children with DS and children with non-specific learning disabilities when working collaboratively on a joint task.

## **CHAPTER 4**

# **STUDY 1: COLLABORATIVE PROBLEM-SOLVING IN CHILDREN WITH DOWN SYNDROME, CHILDREN WITH NON-SPECIFIC LEARNING DISABILITIES AND TYPICALLY-DEVELOPING CHILDREN**

### **4.1 Introduction**

As indicated in Chapter 2, there is little research which addresses the potential of collaborative learning for children with moderate or more severe learning disabilities. In addition, the research, which does exist, is mainly based on a transmission model, that is pairing the child with learning disabilities with a TD or more able learning-disabled child. This study attempted to avoid this model and instead set out to explore the more Piagetian notion of collaboration between peers of equal ability.

There are several reasons for taking this theoretical perspective in study 1. Firstly, in special education there has been a tendency towards didactic forms of teaching and more child-led approaches have been somewhat neglected. With only a few notable exceptions (e.g. Powell & Makin, 1994; Watson, 1996), little attention has been given to the role of meta-cognitive processes in the development of children with learning disabilities. There have also been very few studies which have examined the extent to which the learning-disabled child is capable of directing his or her own learning. Secondly, while it is apparent that TD children may learn through interacting with other



children who are at the same stage of development, it is not clear whether children with learning disabilities would benefit similarly. Learning in this way may be a result of fairly complex cognitive processes such as high meta-cognitive awareness, social understanding and reflexive processes, any or all of which may be beyond the developmental level of the child with learning disabilities.

In view of the dearth of literature that specifically considers peer collaboration in children with Down syndrome (DS), the first study was observational in its design. While it is recognised that the collaboration literature has moved away from considering if collaboration works towards a consideration of which situations best facilitate collaboration, this first study necessarily used a very simple design: similar ability peers worked together on an unstructured task on which neither partner had had any prior training.

In this study, children with DS were partnered with children with non-specific learning disabilities (NSLD) as the inclusion of TD partners might have encouraged a tutoring-type situation. In addition, evidence reviewed in Chapter 3 suggests that interaction between a TD child and a child with DS may be somewhat difficult (Sinson & Wetherick, 1981) and also that, given the choice, children with DS might choose to interact with other children with learning disabilities (Rogers-Warren, 1980). The decision to use only learning-disabled children as partners was also pragmatic. In recent years, despite a definite trend towards inclusion (e.g. Buckley, 2000) significant

numbers of children with DS continue to be educated in special schools in many parts of the UK. Buckley and Bird (2000) noted that inclusion for children with DS was extremely varied and inconsistent. In the most inclusive areas, 67% or more of 5-6 year olds with DS were included in mainstream education; in the least inclusive areas this figure was 28% or less. The education of children with DS in separate provision may be due to many factors, such as the problems associated with full educational integration, negative attitudes of mainstream educators to inclusion (Wishart & Johnson, 1990) and/or resourcing issues and patterns of parental choice. Whatever the reasons, the fact remains that collaborating with TD children might not be a regular option for many children with DS.

Whilst the participants with DS were partnered with children with NSLD, their behaviour and outcomes were also compared to those of ability-matched TD children. The purpose of this was to determine if differences were apparent, to what extent these could be described as being particular to children with DS or whether they were simply associated with that particular range of ability.

As we have seen from Chapter 3, there is some evidence to suggest that children with DS may show characteristic behaviours which may or may not influence the collaborative interaction. For example, children with DS are believed to have socially-biased attentional processes (e.g. Landry & Chapieski, 1990; Kasari et al., 1990) and seem to be more focused in social situations (e.g. Ruskin et al., 1994b). This suggests

that collaboration might be particularly conducive to children with DS. On the other hand, we have seen that children with DS are reluctant to accept a challenge and that one way of avoiding such situations, is by distracting attention away from a task through social means. As the research reporting such behaviour was usually in the presence of an adult (e.g. Wishart, 1991), it was thought it would be interesting to see whether similar behaviour arises with a peer partner. While such behaviour may be more pronounced with a peer as the peer is not in a position of relative power in the same way that an adult is, it is also possible that a peer would be less tolerant of such behaviour.

Of particular interest was how collaborative interaction proceeds with minimal adult intervention. Mutual gaze is believed to be a precursor to play interactions (Argyle & Cook, 1976) and there is some evidence to suggest that children with DS may exhibit atypical gaze patterns which might make interaction problematic (Sinson & Wetherick, 1982). In addition children with DS in particular, and children with learning disabilities in general, may have problems with expressive language which may render collaboration less efficient than for TD children. A question to be explored is whether the expressive language difficulties noted in children with DS have any notable effect on their ability to work in collaborative learning situations.

In terms of cognition, Study 1 was designed to compare approaches to a collaborative task of children with DS, children with NSLD and TD children, with the intention of commenting on the characteristic approach to learning that has been proposed for

children with DS. In particular, how keen children with DS were to attempt the task and how long they would remain motivated by it were foci of interest. It was hoped that the results could then be located within developmental theories of DS, with relation to how far children with DS can be described as showing characteristic profiles of behaviour.

In summary then, the aims of Study 1 were:

- 5) to investigate whether collaboration with a peer partner can positively influence the learning outcomes of children with DS.
- 6) to examine whether the collective performance of children with DS can be differentiated from that of TD children or children with NSLD.

In order to achieve these aims, children with DS were paired with children with NSLD of a similar ability on a task of constructing a model of a house from Lego construction bricks (see appendix B for photograph). The pre-and post-test scores of individual performance were compared and the outcomes of the pairs of learning-disabled children were compared with the outcomes seen in matched pairs of TD children. A more qualitative analysis of Study 1 appears in Chapter 5, which focuses on video-analysis of the collaborative sessions.

## **4.2 Methodology**

### **4.2.1. Participants**

48 children in total participated in the study: 16 children with DS, 16 TD children and 16 children with NSLD. The learning-disabled participants were drawn from 8 special education schools in the City of Edinburgh and county of Midlothian and ranged in age from 10-15 years. The TD participants attended either inner city private nursery schools or a state primary school in the City of Edinburgh and ranged in age from 3-8 years. Certain criteria had to be met for the participants with learning disabilities. School records were checked in order to exclude any children with DS with a diagnosis of the mosaic form of DS, or any other additional complications such as a diagnosis of autism or severe visual or physical impairment. The records of the children with NSLD were checked with a view to excluding those children who had a specific etiological diagnosis for their learning disabilities such as autistic spectrum disorder, Rett syndrome, Williams syndrome etc. Only children without a specific diagnosis for their learning difficulties were included. While it obviously cannot be assumed that the children with NSLD were free of any organic impairment, they are clearly distinguishable from the group of children with DS. Also excluded were children who attended, or had attended a mainstream school either part- or full-time.

Nineteen children with DS were identified, who were suitable to take part in the study, and parental permission was granted for all of them. However, 3 children with DS (two males age 7 and 10 years, and a female age 10 years) were uncooperative to the extent that the researcher was unable to obtain a measure of non-verbal developmental age and

consequently they could not be included in the study. A 100% return rate was also achieved for the 20 TD children chosen to be tested as potential matches for the DS participants on non-verbal developmental age. Of these, 16 were of a suitable developmental age to take part. Forty consent letters were sent out to parents of children with NSLD; only 2 parents refused permission for their child to take part giving a return rate of 95%. All 38 children were tested for non-verbal developmental age. No children from this sample were found to be uncooperative on testing, possibly because teachers had chosen pupils they felt would be amenable.

Subsequently 8 children with DS were matched using non-verbal developmental scores to 8 children with NSLD, with these 8 pairs being allocated to the collaborative condition of the study. A corresponding set of 8 pairs of TD children was formed, matched on non-verbal developmental age to the 8 learning-disabled pairs. 8 children with DS, matched for non-verbal developmental age to the children with DS in the collaborative condition acted as a control group for practice effects. After the data from these groups had been collected, it became clear that a second control group of children with NSLD would be helpful in disambiguating the findings and thus a further group of 8 children with NSLD was added to assess practice effects. In line with the DS participants, these participants were matched for non-verbal developmental age to the participants with NSLD in the collaborative group. The following groups were thus formed:

- 1) DS/NSLD collaborative (n = 16; 8 children with DS paired with 8 NSLD matches)
- 2) TD collaborative (n = 16; 8 matched pairs of TD children. Also matched to pairs in group 1)
- 3) DS control (8 children with DS, matched to DS participants in group 1)
- 4) NSLD control (8 children with NSLD, matched to NSLD participants in group 1)

#### **4.2.2 Matching**

The majority of participants were matched on the performance sub-tests of the Wechsler Pre-school and Primary Scale of Intelligence-Revised (WPPSI-R). Participants who scored above ceiling on this measure were matched using the Wechsler Intelligence Scale for Children (3<sup>rd</sup> edition) (WISC-III) (see appendices C and D for a description of the individual sub-tests of both tests and appendix E for a detailed account of scoring protocol). These performance sub-tests measure primarily non-verbal skill. The reasons for matching on non-verbal skill were twofold. Firstly, children with DS are known to be relatively more impaired on verbally-based skills than they are on overall cognitive ability (e.g. Gunn & Crombie, 1996). Thus matching on the basis of non-verbal skill increased the chances that partners were of a similar ability level for a spatial construction task. Secondly, and more pragmatically, using only the performance-based sub-tests meant that the participants were spared an arduous battery of tests that might have compromised the participant-researcher relationship, lowered participants' self-esteem, with a potential knock-on effect on engagement in the subsequent experimental tasks (Wishart, 1991).



Despite these steps being taken in the interests of validity, reliability and efficiency, it proved extremely time consuming and difficult to match children with NSLD to the children with DS. With children with learning disabilities it is rarely possible to administer standardised tests in the prescribed way. Usually, sessions are lengthier due to having to explain procedures in more detail and occasionally to having to reassure the child. Off-task behaviours may be frequent (Wishart, 1988, 1993b, 1994) further prolonging the test session. In addition, children with learning difficulties often show non-standard profiles of response. For example, while a TD child will usually reach a clear-cut off point in testing, children with learning disabilities may make more mistakes and have more failures en route to their upper limit, which again lengthens the testing time. Administering the performance sub-tests took, on average, between twenty and sixty minutes per child, with the TD participants at the lower end and the learning-disabled participants at the higher end. Consequently, it routinely took two sittings to complete all the WPPSI-R or WISC-III sub-tests for the participants with learning disabilities. This was usually the result of the individual child's inability to cope with such intensive testing but was also occasionally due to clashes between planned test sessions and the school timetable.

Table 4.1 shows the means and standard deviations of the participants in the study. Matching proved to be far from straightforward as the children with NSLD, who were put forward by teachers as being fairly sociable and likely to co-operate with the joint task, typically proved to be of a higher developmental age than many of the participants

with DS. Children who might have been closer matches (i.e. of lower non-verbal developmental age) often had associated problems that would have made collaboration difficult, for example emotional and behavioural difficulties or sensory handicaps. As a result, and despite testing more than twice the number of children with NSLD required for matching purposes, the children with DS were, on the whole, at a slightly lower developmental age than their partners with NSLD, the average difference being 4 months. These differences in the developmental ages of the partners were still considered to be relatively minimal, however, in the circumstances.

Table 4.1: Mean and SD of chronological age and non-verbal developmental age in the collaborative and control groups

	mean chronological age (yrs & mths)	SD of chronological age (yrs & mths)	mean non- verbal developmental age (yrs & mths)	SD non-verbal developmental age (yrs & mths)
DS collaborative	13;3	1;5	5;0	1;4
NSLD collaborative	13;9	1;7	5;4	1;4
TD collaborative	4;1	1;4	5;0	1;3
DS control	11;10	2;11	4;3	0;7
NSLD control	12;8	2;7	5;0	1;2

Due to the inherent limitations on numbers of available participants with DS and the time constraints associated with the collaborative condition the DS collaborative group had to be formed first, with the DS control group being formed afterwards from the remaining available children with DS in the area. As the range of participants available for this group was limited, matching was not as accurate as with the other conditions; there is also a smaller SD indicating that the range of ability in this group was smaller.

Whilst it is acknowledged that there are problems inherent to comparing performance in matched learning-disabled children and younger TD children (mainly because they are at very different stages in social and emotional development and have had different learning histories) it was nevertheless thought that developmental age matches would still be the most informative comparison in terms of examining different learning outcomes. An attempt was also made, however, to match the DS and NSLD participants on the basis of chronological age wherever possible. TD participants were matched for non-verbal developmental age only: matching across the sample for both developmental and chronological age would obviously not have been possible.

While the DS collaborative and NSLD collaborative groups were well matched for age, it was not possible to match the two control groups as closely to the collaborative groups. Again, this is because the control groups were formed after the collaborative group and there were simply less available participants from which to choose.

#### **4.2.3 Experimental task**

The experimental collaborative task was based around copying a model house made from Lego (see appendix B for photograph). A house was chosen as a model because it would be familiar and could reasonably be expected to be gender neutral. Lego construction was chosen for the construction materials as there are certain inherent qualities of Lego that make its materials particularly suitable for use with children with learning disabilities within the age and ability range of the participants in Study 1. Firstly it is familiar, in that most children have usually encountered Lego either at home

or in pre-school or primary education. Secondly, it is also flexible enough to devise a task that is engaging for children of a wide range of abilities and ages but with the potential for either a simple or a fairly complex arrangement of bricks, thus allowing for a large variation in individual scores. Several versions of the house were piloted on nursery-school age children aged 3 to 5 years in order to ensure that the complexity and interest of the design fell within the developmental range of the intended study participants. Lego also has a third advantage over other commercial building sets in that it is age-graded. Lego 'Freestyle' bricks were chosen in particular as they are designed for TD children aged 3-12 years and, as such, would also suit the developmental age of both the learning-disabled and TD participants. Freestyle bricks are also slightly larger than average Lego bricks and are more suitable for children who may have fine motor difficulties.

Using a construction task as the basis for investigating collaboration also has several advantages. Construction tasks require little in the way of expressive language skills which are known to be a relative weakness in children with DS, while non verbal abilities are known to be relatively better than verbal skills (e.g. Gunn & Crombie, 1996; Klein & Mervis, 1999; Miller, 1989; Pueschel, Gallagher, Zartler, & Pezzullo, 1987). Construction tasks also have the advantage of providing constant feedback on how the task is progressing (Tudge, Winterhoff & Hogan, 1996) and may therefore help to maintain motivation for longer.

#### **4.2.4 Design**

A pre-test, intervention, post-test design was used with a gap of 10-14 days between sessions. Pre- and post-test sessions consisted of the child copying the model house unaided while, in the intervention the children worked on the same task in pairs. Control groups had 3 repeat sessions of constructing the house unaided, with the same spacing between sessions.

#### **4.2.5 Procedure**

Prior to the study beginning, the researcher visited the school and met with the children as a group. It was explained to the children what it meant to take part in the research and exactly what would happen. The children were then asked individually at the pre-test stage whether they understood what it meant to participate and whether they agreed to take part (see appendix A for a discussion on ethical issues related to children with learning disabilities).

Participants were given a set of bricks identical to those in the target house, 24 pieces in total. The house was placed in front of the child, but behind the board upon which the child would construct his or her own model. The child's bricks were placed at either side of the board, in a pre-set order in each session. In collaborative sessions, the board was placed approximately between both children with the bricks at either side, in order that both children would have access to the board and also to either pile of bricks.

The researcher then produced the pre-constructed model house (referred to hereafter as the target model) and showed it to the child saying, "Look - here is a house that I've made from bricks. Look - it has a door at the front and a window at the back". The model was rotated in front of the child while the examiner pointed out its features. The researcher then asked, "Look - you've got a pile of bricks that are exactly the same as the bricks in my house. Do you think you could make a house just like mine from your bricks?" It was also explained to the child that it was acceptable to touch the model or move it around. The researcher then said that she had marking to do and sat at the opposite side of the desk, occasionally looking and smiling but without initiating further verbal interaction. Praising and non-specific prompting were given only when the child or children appeared frustrated or began to go off task, but at no other points in the sessions. Physical help was provided only when needed (e.g. if the child did not have the strength to detach a brick from the base). Exactly the same instructions were given in the post-test. The score from the pre-test session acted as a baseline measure against which performance in the post-test could be compared.

In the collaborative session, the model house was placed between both children and the bricks were spread to either side of the children's board so that both children had access to bricks. Exactly the same instructions as in the pre- and post-test were given with the one exception that the children were told to build the house together and to help one another as much as possible. The examiner was again permitted to praise the children's efforts and to bring them back to the task should one or both children go off-task for any



length of time but otherwise remained as a minimal presence in the interaction between the two children. The score that the children achieved together was recorded.

A scoring sheet was devised to score the children's independent and joint versions of the house (see appendix F). The task was broken down into components and points were awarded for correct placement of blocks, for correct colour matching and for correct placement in relation to other parts of the model. Aspects of the model which had appeared more difficult in pilot testing were awarded additional weighting for difficulty. The maximum score possible was 122.

In the case of the control groups of children with DS and NSLD no collaborative session took place. Instead the procedure from the pre-test was carried out in all three sessions, with sessions separated by the same intervals as in the experimental groups. In the control sessions, the examiner was again permitted to praise effort and to respond to off-task conversation, while steering the child's attention back to the task. As with all the collaborative conditions, this was necessary to avoid creating an unnatural social environment which might have been threatening to the child.

Each session lasted a maximum of 15 minutes as pilot testing had indicated that after 15 minutes, participants had usually either completed the task or were at a stage beyond which no further improvement to the model was likely to be made. The session was therefore terminated after this time limit, whether or not the task had been completed.



Alternatively, the session could be terminated at an earlier point if the participant(s) had completed the task to their satisfaction, if the participant requested that the session be terminated, or if the participant(s) consistently refused to co-operate. In cases where the session was to be terminated before the time limit, the researcher confirmed this by asking “Are you sure you are finished?” whereupon the subject(s) had to agree that he or she had finished before the session was considered terminated.

All sessions were video-taped. Pre- and post-test sessions were video-taped for the protection of both the participant and the researcher only; the video-tapes of the collaborative session(s) were the basis for analysing the collaborative interaction (see Chapter 5). The camera was placed directly opposite the participant(s) in an unobtrusive spot. Occasionally, participants would notice and question the presence of the camera. In such cases, the researcher explained that the camera was there to make a copy of how well the children built the house, in case the researcher could not remember afterwards.

### **4.3 Results**

To recap, Study 1 addressed two main questions:

- 1) Can children with DS benefit from a collaborative problem-solving task?
- 2) Are there group differences when comparing the performance of this group to TD children and children with NSLD of equivalent developmental status?

In order to address these questions, the analysis concentrated mainly on the change in pre- to post-test score on the Lego construction task. For the purpose of looking at group differences, the collaborative group of learning-disabled participants was split into two distinct groups (DS and NSLD). Along with the two control groups of DS and NSLD children, this gives a total of 5 groups across which comparisons could be made:

- 1) DS collaborative (n = 8)
- 2) NSLD collaborative (n = 8)
- 3) TD collaborative (n = 16)
- 4) DS control (n = 8)
- 7) NSLD control (n = 8)

**4.3.1 Pre- and post-test scores**

Although participants had been matched on the basis of non-verbal ability, it was thought prudent to check whether group differences in pre-test scores existed. Table 4.2 shows the mean and standard deviation of pre- and post-test scores in the 5 participating groups. A one-way analysis of variance confirmed that no differences existed in pre-test score ( $F(5,42) = 1.70$ ;  $p>0.05$ ). This indicates that the groups were adequately matched. The Levene test also indicated that there was no evidence for heterogeneity of variance within the groups on pre-test score ( $F(5,42) = 0.734$ ;  $p>0.05$ ).

Table 4.2: Mean and SD of pre- and post-test Lego scores in the 5 participant groups

	pre-test		post-test	
	Mean	SD	Mean	SD
DS collaborative	34.1	32.1	46.7	38.4
NSLD collaborative	57.2	24.7	59.1	13.0
TD collaborative	50.4	30.7	57.5	36.2
DS control	30.7	20.1	36.5	20.3
NSLD control	39.2	21.8	42.2	22.1

Comparison of pre- and post-test means indicates that the largest mean pre-to post-test increase in score is found in the DS collaborative group. Large standard deviations are found in both the DS collaborative and TD collaborative groups, suggesting that scores in these groups showed a larger variation than the other groups.

**4.3.2 Pre- to post-test change in Lego task scores**

*Collaborative groups*

Figures 4.1 – 4.3 show the difference in pre- to post-test Lego scores for each individual participant in the collaborative groups. The first point to note is that the pre-post test change is not unidirectional in any group. In other words, while more children showed an increase in post-test score relative to their pre-test score, many showed a decrease. From these figures it is apparent that 6 of the participants with DS and 4 with NSLD showed a change in a positive direction. When scores in a negative direction are removed, the mean increase for the DS group was 21 points, with mean increases of 16.5 and 18.8 for the NSLD and TD groups respectively. In the NSLD group the mean increase of 16.5 points was disproportionately affected by one participant who showed a

large increase of 34 points in pre- to post-test score. Most of the other increases in score were around 10 points. In the group of TD participants 11 of the participants showed increases in score, with a wider variation in amount of increase in score than is seen in either the DS or NSLD groups.

Figure 4.1: Pre- to post-test change in score  
(DS collaborative)

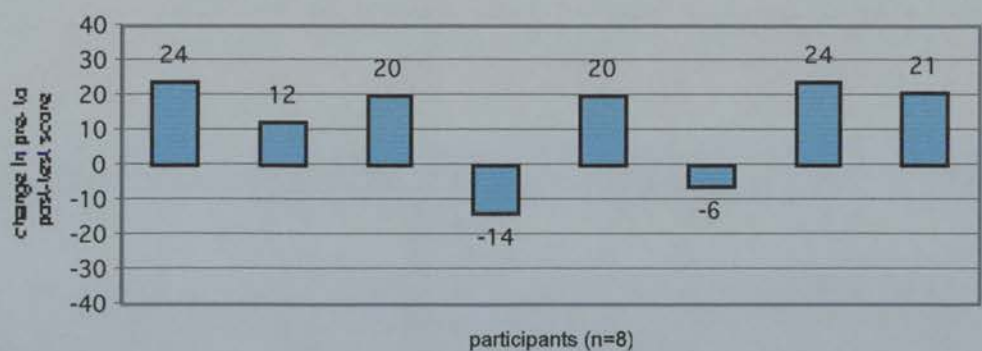


Figure 4.2: Pre- to post-test change in score  
(NSLD collaborative)

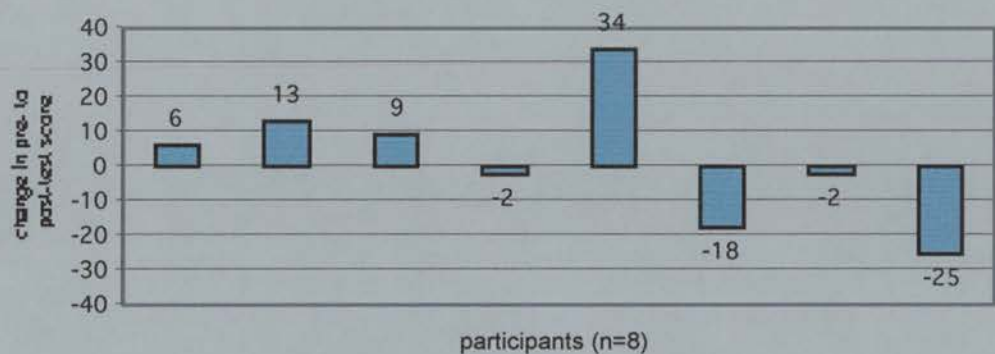
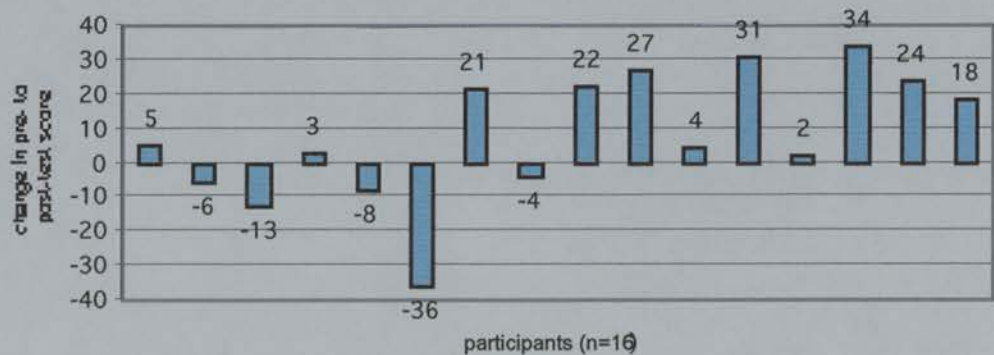
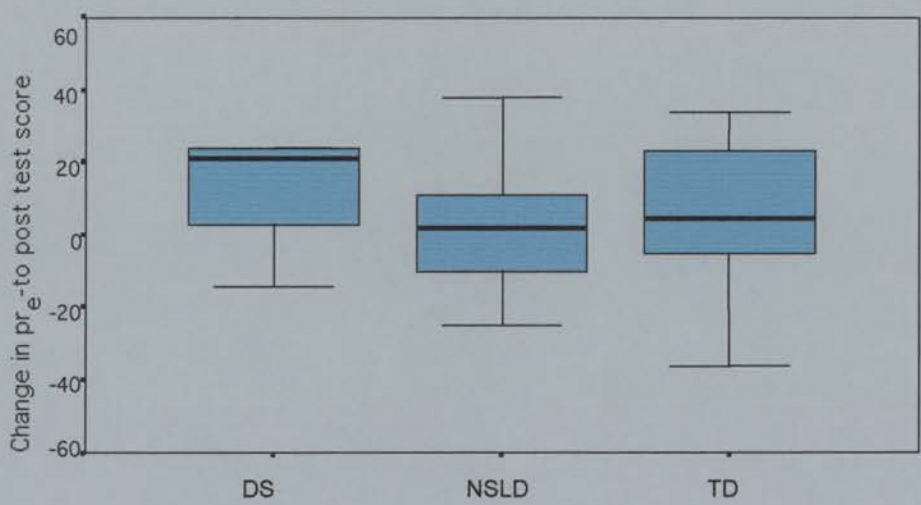


Figure 4.3: Pre- to post-test change in score  
(TD collaborative)



The profile of pre-post test changes is further confirmed by figure 4.4, which displays boxplots for all pre-to post-test change in scores for the three groups. From this, we can see that the median score for the DS group is highest; in the NSLD and TD groups, the median hovers nearer to zero. In addition, the range is smaller for the DS group, indicating a more consistent pattern of change.

Figure 4.4: Boxplots of pre- to post-test change in collaborative groups

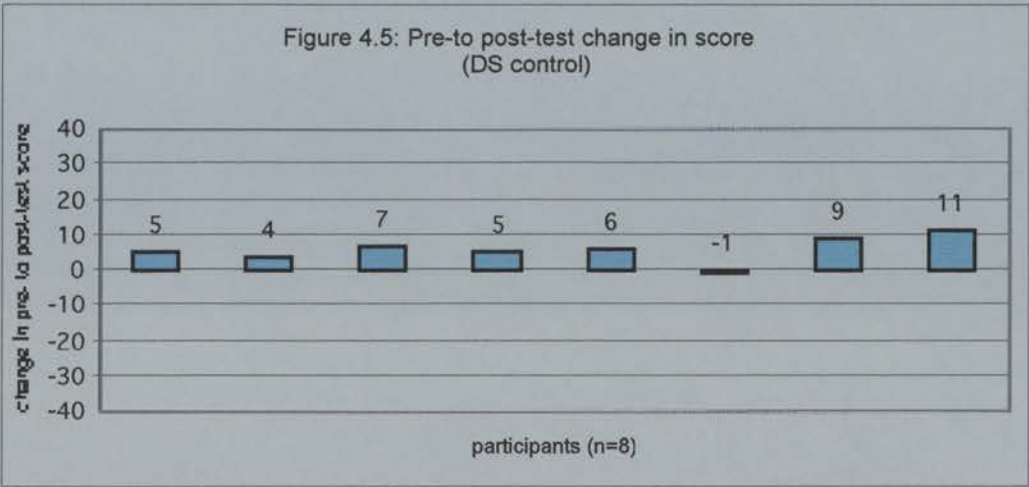


*Control groups*

Two control groups of children with DS and children with NSLD repeated the task three times without any collaboration, in order to control for practice effects. Figures 4.5 and 4.6 show the difference between pre- and post-test scores for these groups. From figure 4.5 it is apparent that the increases in score in the DS control group were less than those



seen in the DS collaborative group. Although one decrease in score is apparent from pre- to post-test, the majority of increases are relatively small.



Individual changes in score in the control group of children with NSLD are represented by figure 4.6. These participants, like the DS control group repeated the task three times without any collaboration.

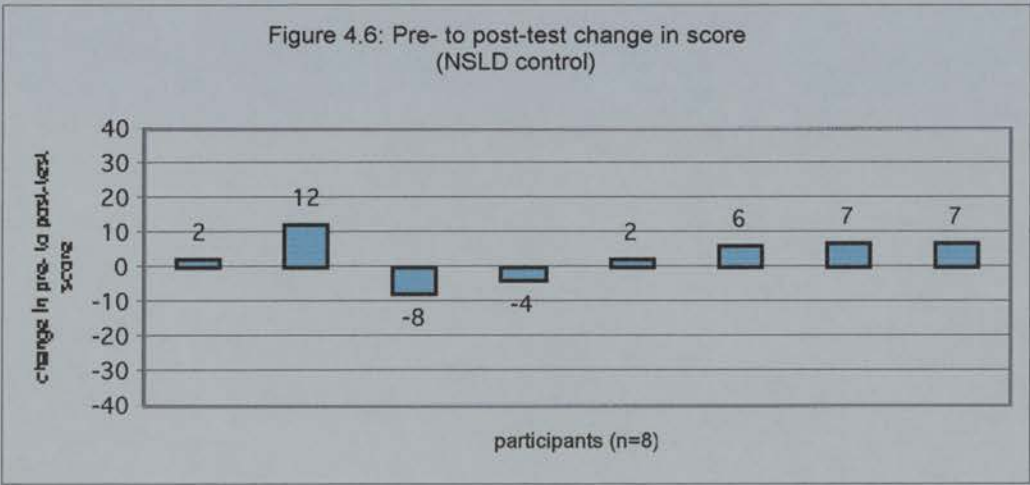




Figure 4.6 indicates increases in score from pre- to post-test that are less variable than those seen in the NSLD collaborative group. Two regressions are also noted in this group.

#### **4.3.3 Group differences in pre- to post-test score following collaboration**

In order to examine whether group differences in performance following collaboration exist, the data were subjected to a mixed (2 x 5) analysis of variance, where pre- and post-test scores comprised the repeated measure and group was the between-subjects variable. This indicated an effect of pre- to post test improvement for all participants as a single group ( $F(1,43) = 6.98, p < 0.05$ ), but showed no between group effect ( $F(4,43) = 1.27, ns$ ) and no effect of interaction effect between pre- to post-test score and group ( $F(4,43) = 0.61, ns$ ).

#### **4.3.4 Patterns of mean score across groups**

Although no significant differences in group performance exist, it is of interest to examine the pattern of mean scores for each group. Figures 4.7 to 4.11 represent the mean score per group for the pre-test, joint session and post-test. In the case of the DS control and NSLD control groups this corresponds to 3 simple repeat sessions in which each child worked independently. In the collaborative conditions the score achieved in the joint session is a score which cannot be attributed to either child but which is of interest, nevertheless, in cross-group comparisons.

Figure 4.7: Mean score per test session  
(DS collaborative)

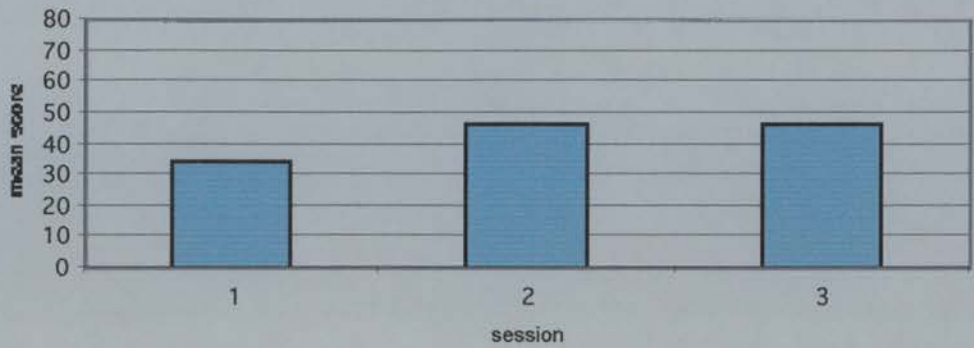


Figure 4.8: Mean score per test session  
(NSLD collaborative)

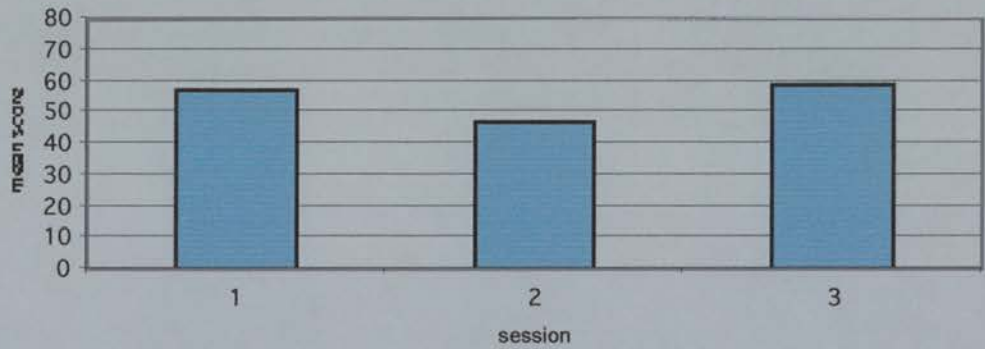
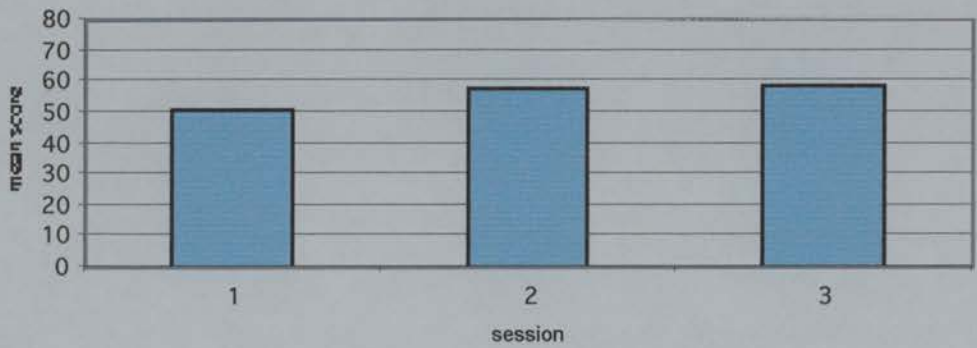
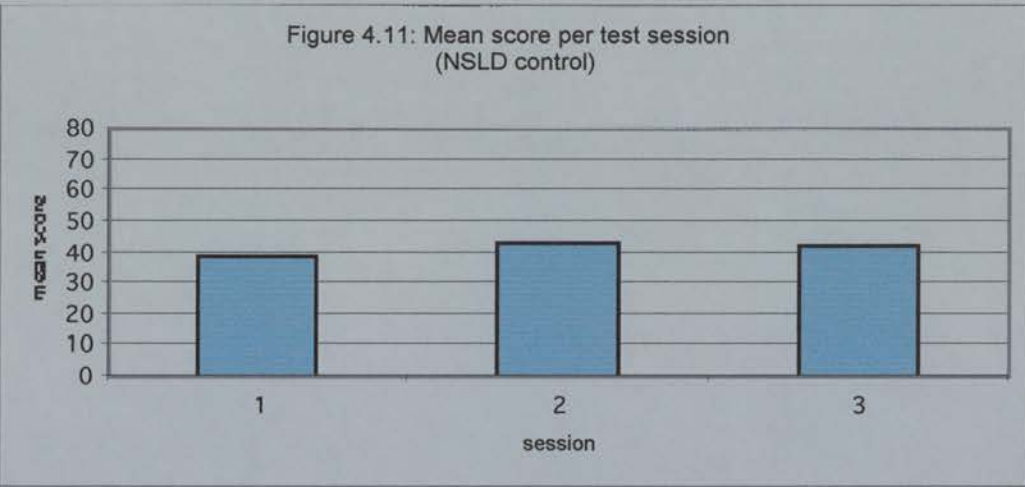
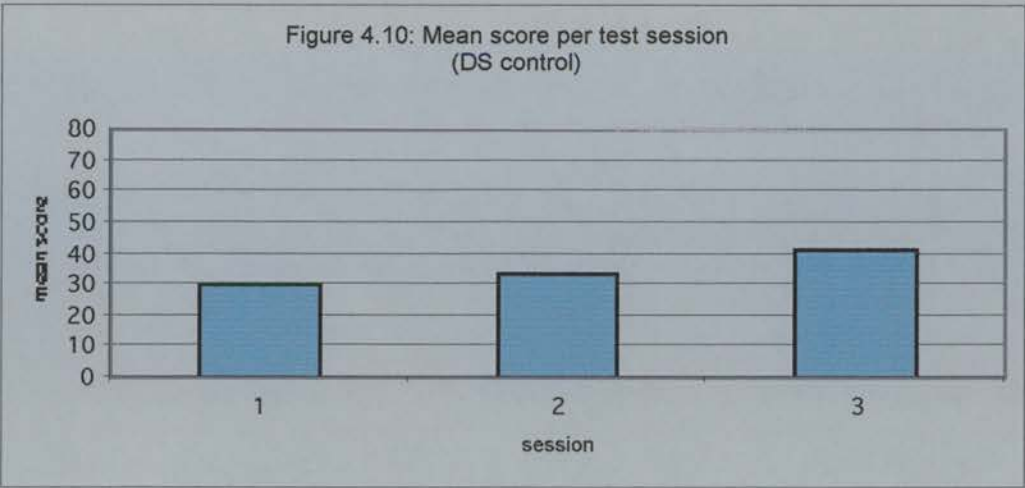


Figure 4.9: Mean score per test session  
(TD collaborative)





Firstly, a different pattern can be seen in the DS and NSLD participants who collaborated with a partner. The average scores from the DS collaborative group shows an increase from pre- to collaborative session, followed by a post-test score that is roughly equivalent to the collaborative session score. This is approximately the pattern that one might expect to see after successful collaboration: the joint score of the partners is more than the individual score achieved in the pre-test session. A similar score in the

post-test session to the joint session indicates that some of the learning seen in the collaborative session has carried over to the post-test session in which the child attempts the task unaided. This pattern of results is also seen in the TD collaborative group. In the NSLD collaborative group, however, a different pattern is seen. The average change in score in the joint session is considerably less than that seen in the pre-test session. This is despite one very large individual increase score which will have pulled up the average. This is puzzling, given that one would expect joint scores to be at least as high as the highest individual pre-test score. While the average post-test score is higher than the average pre-test score, the difference is less than the increases seen between pre- and post-test scores in the DS and TD collaborative groups. This pattern suggests that the participants with NSLD in the collaborative group did not work to their full potential in the collaborative session.

In the DS and NSLD control groups, a pattern of a small but steady increase in average score is noted, although in the NSLD control group the post-test score is slightly lower than the middle session. Of particular interest is the different pattern of score increase seen between the DS collaborative and DS control groups as the different patterns found these two groups might imply different processes. While the pattern seen in the DS collaborative group conforms to expectations of a collaborative paradigm, the scores of the DS control group climb steadily over the three sessions in smaller increments. This steady improvement is more suggestive of improvement through practice than the pattern seen in the DS collaborative group.

#### **4.3.5 Pre- to post-test regression**

Although mean pre- to post-test scores increased in some of the groups tested, relative decreases in score from pre- to post-test were also seen in individuals within all groups. While small decreases in score are likely to be chance occurrences, larger regressions are likely to be more significant. Notable regressions (of ten or more points) were seen more often in the DS/NSLD pairings than in the TD pairings. In some cases only one partner regressed while the other did not, but in some cases both partners regressed, suggesting that that particular pairing may have been particularly unconstructive. This possibility will be examined further in the video analysis of the sessions to be reported in chapter 5.

### **4.4 Discussion**

#### **4.4.1 The effect of peer collaboration on performance**

This first study was an exploratory investigation of the effects of collaboration on the problem-solving skills of groups of children matched for non-verbal ability. Although some individuals appeared to benefit from collaboration with a partner, as evidenced by large pre- to post-test changes in score, there was little evidence of group effects, either in terms of collaborative versus control groups or between groups. The fact that some individuals did appear to benefit from peer collaboration is encouraging, given the relatively low developmental ages of the children involved and given that the task was not structured by an adult, nor had the participants been given training prior to the task.

The lack of significant differences between the collaborative and control groups is worth exploring further. The most obvious explanation for this result is that, despite the large increases in score seen in some participants, we cannot discount the explanation that practice effects must, to some extent, account for a certain proportion of improvement.

However, there are also other interpretations which should be considered. Firstly, both the DS and NSLD control groups are characterised by small increases in score, with a few small decreases in score from pre- to post-test. The collaborative groups, on the other hand, show generally larger increases in score from pre- to post-test but, at the same time, show some large decreases in score also. The effect of this will be to bring the means of the two groups closer together and make group differences less likely.

From this we might say that, while collaboration appears to have had a positive effect on some individuals, for others it had the effect of causing post-test scores to be much less than pre-test scores. In sum, collaboration effects appear to be very variable. When children collaborate well, it can have beneficial effects on performance however, when it does not function as well, it can actually depress performance. This is particularly apparent in the present study, where adult intervention and structuring of the task was minimal. Some pairs of children did indeed seem to find collaborative interaction difficult, as evidenced by a lack of dialogue and a reluctance to engage with the peer partner.



A second area which merits discussion is the lack of significant differences between the collaborative and control groups were not different enough to produce an effect. While the researcher did not provide explicit feedback or guidance on the task, it is recognised that it would have been difficult to avoid positive encouragement such as smiling and meeting the child's gaze. Such non-specific positive reinforcement may have had a positive effect on the learning-disabled participants as it possibly prevented them from becoming overwhelmed by the task demands. As described in Chapter 3, children with learning disabilities may exhibit an outer-directed approach to problem-solving (Turnure & Zigler, 1964), that is they may be particularly motivated by external factors such as approval. The presence of the adult may therefore have increased the likelihood that these children would engage with the task

It is also worth exploring the *pattern* of mean scores in each group across test sessions. The DS collaborative group and the TD collaborative group showed a similar pattern of results. This pattern consisted of a relatively high increase in mean score from the pre-test to the collaborative session, followed by a post-test score that was roughly equivalent to the mean score in the collaborative session. This might be explained by the pooled resources of the two children together allowing more progression on the task than the individual children could have achieved alone, while the fact that the higher score was maintained in the post-test suggests that some learning had carried over.



The pattern of results seen in the group of participants with NSLD is suggestive of a different outcome. Here, the average collaborative score was less than the score achieved by the individual children at the pre-test. This would suggest that the participants with NSLD did not, for some reason, perform as well in the collaborative session as they had in the pre-test session. The reasons for this can only be speculated on, but it is possible that the presence of the partner with DS acted as a distractor to their NSLD partner and thus did not allow them to work to their full potential. The mean scores of the DS and NSLD control groups increase steadily across sessions, a pattern which is possibly more suggestive of a practice effect.

#### **4.4.2 A note on matching**

In view of the fact that little research has addressed the issue of collaborative learning in children with learning disabilities, it is heartening that children with DS and NSLD appear to benefit as much from collaborative learning as the TD children of the same developmental age. Of course, group differences may have been more apparent had the group of TD children been older; there is, as yet, much debate over the efficacy of very young children as collaborators. The pairs of TD children were chosen to match the non-verbal developmental ages of the experimental group of DS and NSLD children and ranged in age from 3 years to 8 years with 11 of the 16 participants being under the age of 5 years. The literature on TD children suggests that pre-school children do not cooperate well with each other (e.g. Strayer & Trudel, 1984) and that they find collaboration difficult to sustain.

Had the TD participants then been matched to the learning-disabled group for chronological age rather than non-verbal developmental age, it is quite possible that a more favourable outcome for the TD children would have been seen. This fact highlights a problem inherent in matching learning-disabled children with similar ability children who are chronologically younger. Although they may have a similar level of skill on specific tasks, how this skill is manifested in everyday problem-solving situations may well be different, therefore compromising the validity of comparisons at certain levels.

In some of the older pairs of the children with DS and NSLD, both children did benefit from the collaboration. This is interesting because although the pairs of learning-disabled children were chronologically older than the pairs of TD children, in some cases the non-verbal developmental age was at the level of a pre-school child. This would suggest that although the learning-disabled children are functioning at a relatively low level of intellectual functioning, they might, nonetheless, have the skills of an older TD child when it comes to sustaining and ordering collaboration.

Whilst a control group of TD children of the same chronological age would have been interesting, it would not have been feasible as the same task could not then have been used for both the learning-disabled and TD groups, as older TD children would have been much more conceptually advanced. It is extremely unlikely therefore, that they would have been prepared to engage with the task for any significant level of time.

#### **4.4.3 Theoretical implications**

As the pairs of children who participated in Study 1 were of similar ability, it could be considered to be a classic Piagetian peer collaboration design. This is contrary to the bulk of previous research on collaborative learning in children with learning disabilities, the majority of which is focused on adult or peer tutoring models, where one partner is an obvious expert.

The results from Study 1 demonstrated that, although there was no obvious expert, some of the pairs were able to benefit from the collaborative session to the extent that they were able to progress the model further in the post-test than they had been able to do alone in the pre-test.

The classic Piagetian explanation for this improved understanding of the task would be, that negotiating how parts of the model were to be built might encourage a child to reflect on his or her own strategies for building the model, and consequently lead to a higher level of understanding or at least a consolidation of one's own knowledge. Indeed there is some evidence to suggest that this might have been the case. This is explored further in the next chapter which examines the evidence for instances of cognitive conflict during the sessions.

However, as was stated in Chapter 2, even neo-Piagetian research has not relied on the mechanism of socio-cognitive conflict alone to explain how collaboration might lead to improved understanding. There is evidence also for the benefits of joint dialogue and

consensus – factors which would equally sit well within a Vygotskian account of collaboration. It is unlikely that socio-cognitive conflict was the sole factor in the improvements seen, as it was not apparent in the dialogue of every dyad that showed improvements. In fact, it was noted that in some dyads that there was very little in the way of task-related dialogue. From this, we might infer that the successful participants were able to learn from the collaborative session in other ways.

To return to the earlier discussion on the collaborative literature, it was stated that both neo-Piagetian and neo-Vygotskian researchers place a high emphasis on the role of consensual co-operation in reaching a successful outcome. First-level reviews of the video-tapes of the collaborative sessions revealed that in some of the pairs who had shown post-test improvements, there was evidence of a very reciprocal, co-operative approach to the task.

Such speculation is potentially useful in terms of finding a theoretical framework within which to situate the results. Some of these factors will be examined more closely in the next chapter, which attempts to examine some of the processes involved in the collaborative sessions.

## **CHAPTER 5**

### **STUDY 1A: A QUALITATIVE ANALYSIS OF COLLABORATIVE INTERACTIONS IN STUDY 1**

#### **5.1 Introduction**

In Chapter 3 the results of Study 1 were analysed in terms of quantitative measures of performance using pre- to post-test comparison of scores. Such an analysis was necessary as an objective measure of the extent to which collaboration may or may not have been beneficial and indeed, is the most common method of evaluation used in studies of collaboration in TD children. In addition to this, however, it was felt that a more qualitative analysis could be illuminating in describing how the three different groups of children reacted to collaborative problem-solving situations, both in terms of their social responses and their approaches to the task.

There seems to be a pervasive view that children with moderate to severe learning disabilities will not benefit particularly from collaboration in which there is no obvious 'expert'. Indeed, the results from Study 1 indicated that the effects of peer collaboration could be very variable. As some individual participants did not improve their scores, and some actually regressed after collaboration, a better understanding of the dynamics of collaboration in children with learning disabilities is essential.

This chapter reports the findings from an analysis of the videotapes of the collaborative sessions within Study 1. Essentially, the analysis focused on the behaviours of the 3 different groups of children during collaboration. The main focus of this thesis is children with Down syndrome (DS) and to this end, the behaviours of the children with DS were compared to those of the TD children and the children with NSLD.

The developmental-difference controversy and the behavioural phenotype approach outlined in Chapter 3 suggested that children with DS might show some specific types of behaviours which are associated with that syndrome. According to this approach, we might expect to see behaviours in the group of children with DS that differ from both the groups of children with NSLD and the TD children. On the other hand, some theorists have argued that development in DS may be characterised as simply a slowed-down version of typical development. According to this theory we would not expect to see any differentiating behaviours between the group of children with DS and those with NSLD. In fact, we would expect to see little difference between the group of children with DS and the group of younger TD children, with the exception of perhaps differences between the younger TD children and the older children with learning disabilities in terms of the social skills evidenced in collaborative contexts. The children with learning disabilities were by definition chronologically older than TD children to whom they were matched on intellectual skills, therefore they could perhaps have had more sophisticated social skills due simply to their extended experience of social interactions.

The types of behaviour to be analysed in Study 1a for possible group differences were informed by previous research which has indicated a specific profile of behaviours that are characteristic of DS and are discussed below. Essentially, Study 1a addresses the question of whether the group of children with DS differed from either the group of children with NSLD or the TD group in terms of their social interactions and their approaches to joint problem-solving during collaborative sessions.

## **5.2 Social interaction and problem solving**

As discussed in further detail in Chapter 3, while there has been a pervasive stereotype that children with DS have intact social skills, relative to children with other types of learning disability, the evidence for this has not been convincing. However, some authors have suggested that children with DS may show specific differences in attentional and problem-solving approaches when in a social setting. Ruskin and colleagues (1994b) showed that children with DS were more focused and showed less off-task behaviour in socially-mediated situations than developmental-age matched TD children. They suggested that the participation of the researcher might hold the attention of the infant with DS more than situations in which the researcher remained relatively passive. Further evidence for the benefits of socially interactive situations comes from Schlottman and Anderson (1975). They provided evidence to show that children with DS have more of a propensity to inspect or manipulate a toy in co-operation with another child than do other groups of children.



Such studies suggest that children with DS are likely to be co-operative in a collaborative situation and find working with another person a particularly amenable forum for learning. Indeed, the quantitative results from Study 1 endorse this probability. However, other evidence has also shown that children with DS are more interested in social interaction than in object-centred interaction (Kasari & Freeman, 2001; Kasari et al., 1995), suggesting that the presence of a partner may actually be a distracting factor. This may be related to the fact that children with DS sometimes fixate on social aspects while ignoring other components of a situation (Berger & Cunningham, 1981; Gunn, Berry, & Andrews, 1982; Krakow & Kopp, 1983). In this case, the presence of a partner could actually be detrimental to learning.

### **5.3 Approaches to learning**

It was also proposed in Chapter 3 that children with DS show a specific profile of what might be termed cognitive strengths and weaknesses (e.g. Chapman & Hesketh, 2000). In addition to this, there is a growing body of evidence to suggest that the cognitive development of children with DS may also be influenced by a characteristic approach to learning within this specific population. For example, it is thought that the relative decline in the growth of developmental age in children with DS and their failure to consolidate skills may be partly due to their counterproductive approach to learning new or challenging skills. Wishart (1990) suggested that children with DS may specifically attempt to evade tasks which are slightly ahead of their current level thus foregoing the opportunity to practice established skills or learn new skills. Wishart and colleagues

(Wishart, 1991; Pitcairn & Wishart, 1994) have provided evidence that children with DS will often show inappropriate or exaggerated social interaction, such as prolonged eye contact, once a task begins to challenge their abilities. These behaviours are not social in the sense that their goal is to interact, rather their aim is to provide a means of avoiding engaging with the task. Accordingly, within the present study it was decided to analyse the video-tapes of interactions carefully for level of engagement and eye contact.

The avoidance of challenging learning situations may be closely related to levels of mastery motivation in children with DS. Mastery motivation may be defined as levels of intrinsic pleasure in task mastery. Some researchers have suggested that levels of mastery motivation are low in children with DS (Berry, Gun & Andrews, 1984; Landry & Chapieski, 1990; Dayus, 1999; Ruskin et al., 1994a) and in support of this viewpoint, studies have shown that children with DS often relinquish control of a task after short periods (Wishart, 1991, 1993a). In the context of the investigation being reported here, low levels of intrinsic pleasure in task mastery might be reflected by the amount of time the child with DS spends attending to the task, before going off-task, and the extent to which they take responsibility for working at the joint task.

Mastery motivation is closely related to the notion of outer-directedness, in that children who are not motivated by the intrinsic process of mastering a task may be likely to be motivated by external praise and affirmation. Outer-directedness is defined as utilising external cues to solve problems, rather than relying on one's own internal problem-solving abilities. Turnure and Zigler (1964) originally hypothesised that the lower the

cognitive developmental level of the children, the higher the level of outer-directedness. Thus children with learning disabilities tend to be more outer-directed than TD children, and children whose learning disability has organic origins are more outer-directed than children with learning disabilities, for which no organic cause is known (Yando & Zigler, 1971).

An outer-directed approach can be harmful in that it can undermine problem-solving abilities. It has been suggested that outer-directedness as measured by glances towards another during problem-solving may be associated with less efficient task performance (Bybee & Zigler, 1998). Accordingly, the children's reliance on the examiner was also considered by noting how often they requested help or solicited praise or affirmation.

#### **5.4 Mechanisms underpinning collaboration**

In Chapter 1, different mechanisms were discussed that have been thought to be influential in the process of collaboration. Research into collaboration in TD children has identified socio-cognitive conflict as a possible facilitator (Doise et al., 1975, 1976; Mugny & Doise, 1978) while other researchers have highlighted the need for consensus and reciprocity (Light et al., 1994; Bearison et al., 1986). Children may sometimes appear to be working collaboratively when, in fact, they are simply working in parallel without any reciprocity. As most of the literature concerned with children with learning disabilities has focused on the tutoring paradigm, it has tended to be outcome-oriented. In addition to determining whether group differences existed, the video-analysis therefore aimed to determine whether any evidence existed for the role of socio-

cognitive conflict in the interactions seen. There was also a consideration as to what extent the children could be said to be genuinely collaborating in the sense of a reciprocal two-way interaction. As a result, the video-analysis looked for instances of speech that might reflect the initiation of socio-cognitive conflict. It also considered to what extent the interaction could be considered to be a truly joint effort by analysing what percentage of time spent on-task might have been truly co-operative in the sense that both partners were working on or attending to the same part of the model at the same time. The remainder of the time spent on-task was considered to be parallel engagement.

Evidence for reciprocity may also come from speech. Instances of reciprocal dialogue may be collaborative or may be more discursive and indicative of socio-cognitive conflict. While moderate amounts of conflict are thought to be facilitative, too much conflict may lead to aggression (Howe & Tolmie, 2001) and may be implicated in poorer outcomes. The analysis reported here attempted therefore to identify whether conflict was a feature of the interaction and whether the types of speech used within the dyads were positively or negatively correlated with outcome.

Research into collaborative learning in TD children has strongly emphasised the role that reciprocal speech has to play in a positive outcome (Bearison et al., 1986; Kruger & Tomasello, 1986). Certain types of speech are thought to be facilitators of learning,

particularly when used in a reciprocal setting. The types of speech used throughout the collaborative sessions were therefore also investigated.

In sum then, the questions that the video-analysis addressed were to be informed both by the literature on the cognitive development of the child with DS and the theoretical backgrounds to peer collaboration within the TD child. Essentially the video-analysis set out to identify:

- 1) whether group differences existed in terms of social interaction and approaches to problem-solving in children with DS, children with NSLD and TD children;
- 2) the extent to which the joint sessions could be considered to be truly collaborative;
- 3) possible indicators of cognitive conflict and/or reciprocity.

## **5.5 Method**

### **5.5.1 Participants**

The participants were the 32 children who had taken part in the collaborative sessions in Study 1. They were 8 dyads of DS/NSLD participants and 8 dyads of TD participants. As described in Chapter 4, each child was individually matched to their partner for non-verbal ability with the groups of DS/NSLD and TD children also of comparable levels of non-verbal ability.

Table 5.1 Mean and range of WPPSI/WISC non-verbal developmental age and chronological age in the 3 collaborative groups

group	n	mean chronological age (range)	mean non-verbal developmental age (range)
DS	8	13;3 (10;9 - 15;8)	5.0 (3;8 – 8;0)
NSLD	8	13;9 (10;8 - 15;10)	5.4 (3;9 – 8;3)
TD	16	4;1 (3;4 - 8;0)	5;0 (3;5 – 8;7)

5.5.2 Video analysis

Video-tapes of the collaborative interactions were analysed in the following way. Firstly, all videos were viewed informally and notes made of the types of speech or behaviour occurring naturally. Following this, and with the benefit of the collaboration literature and the literature on DS, a coding system was devised. Some behaviours which were commonly coded for in the TD literature and which distinguished successful and unsuccessful collaboration did not often appear in the groups of learning disabled children. Similarly, behaviours arose in the learning disabled groups which were not noted in TD groups. Consequently, the coding system could not be based around any pre-existing schedule. It was, in fact, a hybrid of the most salient behaviours in collaborative problem-solving plus those behaviours which have been identified in the literature to differentiate between children with DS and children with learning disabilities of other aetiologies.

5.5.3 Coding system

Continuous sampling was used with all occurrences of the behaviours listed below being noted. Continuous sampling, although time consuming, provides a more accurate record

of behaviours than time sampling (i.e. coding at set intervals) (Martin & Bateson, 1993).

The behaviours were coded under 3 main headings:

- 1) level of task engagement
- 2) non-verbal behaviour
- 3) verbal behaviour

Some categories of speech were taken from Garton and Pratt (2001). All categories of behaviour were mutually exclusive. A more detailed description of the definitions for each behaviour may be found in appendix G, however a brief description of the categories of behaviours under each heading is given below:

1) *Levels of task engagement*

During the collaborative sessions, each individual participant was judged to be in one of the three following mutually exclusive states:

- off task
- on task (working individually)
- on task (working in collaboration)

Obviously where children were deemed to be on task and collaborating, both children would be coded as being in this state at the same time. However, outwith episodes of collaboration, individual participants could vary in the extent to which they were either on task and working individually or off-task.



## 2) *Non-verbal behaviour*

Two main categories of non-verbal behaviour were coded for each individual participant:

- physical conflict
- eye contact

Physical conflict behaviours consisted of snatching bricks etc, blocking the partner's access to the task materials, or pushing. Eye contact was measured simply by onset and offset of time spent looking at the partner. Noting onset and offset allowed durations as well as instances to be computed. Instances of joint eye contact were measured by both partners making eye contact simultaneously.

## 3) *Verbal behaviours*

Utterances produced by individual participants during the collaborative sessions were coded according to the categories set out in table 5.1.

Table 5.2: Coding for verbal behaviours

category	example
commands	"Do it like that!"
descriptive/procedural/planning statements	"That bit goes there.." "I think we should try it that way first this time."
task-related questions	"Where does this bit go?"
reminders	"Remember she said to match the colours too."
contradiction/disagreement	"No it doesn't - it goes there!"
pointing out mistakes	"You've done that bit wrong."
target model as point of reference	"Look - it's yellow on that one (The target model)."
agreements	"Oh yes, you're right..."
invitations	"What do you think?"
offers to help	"I'll show you"
positive personal	"You're good at that."
negative personal	"It was Jamie's fault - he can't do it" "You're stupid"
rebuttal of help	"Leave it - I can do it myself!"
request to quit	"I've had enough now." "Can we finish now?"
excuses	"I can't do anything - I'm too tired"
off-task	"I like the Spice Girls - especially Baby Spice."
researcher-directed	"Are we doing well Miss?"
task-negative	"Stupid House!" "It's a horrible house"
task modification	"We're not making that house (target model) - we're making a different one."
self-assessment of ability	"I'm stupid!"
'other'	inaudible, incomprehensible or incomplete speech

Each category of verbal behaviour was coded separately, however, some categories of speech were deemed to be similar enough to be grouped together for analysis purposes.

Table 5.2 shows the main groupings, together with categories within that grouping.

Table 5.3: Verbal behaviour groupings

grouping	categories of verbal behaviours
goal-directed	commands descriptive/procedural/ planning task-related questions reminders
cognitive conflict	contradiction/disagreements pointing out mistakes target model as point of reference
facilitators	agreements invitations offers to help positive personal statements
task avoidance	requests to quit excuses

The following types of speech remained as categories within their own right: partner-negative, researcher-directed, off-task, task modification, task-negative, self-assessment and 'other'. In addition to the above behavioural categories, the total time to complete the task was computed for each dyad.

**5.5.4 Reliability of analysis**

Analysis of the video-tapes was checked for both inter-observer and intra-observer reliability. Two video-tapes which contained examples of all behavioural categories were re-coded in full by the first observer. There was an 80% overall agreement between codings of categories, suggesting that intra-observer reliability levels were acceptable. 10% of tapes of the total 32 participants scored by the researcher originally was also checked for inter-observer reliability. For each behaviour an independent observer

observed 3 participants (1 DS, 1 NSLD, 1 TD). Overall, tapes of a total of 14 different children were used (4 with DS, 5 with NSLD and 5 TD).

The independent observer who was blind to the purpose of the study was given a description of each behaviour and then allowed a short practice session. Discrepancies in scoring were discussed. The observer then scored 3 children for each behaviour as described above. The observer was told in advance to code for that particular behaviour but that it might or might not appear on any given tape. Reliability measures were obtained for each behavioural category (tables 5.3 – 5.5). There was judged to be agreement that a behaviour had occurred if the onset time coded by the second observer occurred within a 3-second window of the event coded by the first observer. In the case of duration, there was judged to be agreement if the offset time was also within a 3-second window.

Percentage scores were used to code for reliability where appropriate. However, when coding behaviours that are mutually exclusive and where at least one category must always be coded for, there is a higher probability of agreement by chance which must be taken into account by using a more conservative estimate of inter-observer reliability. For this reason, Cohen's Kappa (Cohen, 1960) was used to estimate reliability for level of engagement and eye contact. The following tables indicate that inter-observer reliability rates were acceptable.

Table 5.4: Inter-observer reliability for level of engagement

Behaviour	Kappa score
engagement	0.82

Table 5.5: Inter-observer reliability percentage for non-verbal behaviour

Behaviour	% agreement
physical conflict	0.97
eye contact	0.78

Table 5.6: Inter-observer reliability percentage for verbal behaviours

verbal behaviour	% agreement
commands	76%
description/procedural/planning	75%
task-related questions	86%
reminders	90%
contradiction/disagreements	91%
pointing out mistakes	88%
target model as a point of reference	89%
agreements	79%
invitations	82%
offers to help	74%
positive personal	92%
negative personal	88%
rebuttal of help	71%
requests to quit	85%
excuses	82%
off-task	77%
researcher-directed	80%
task-negative	81%
task modification	78%
self-assessment of ability	81%
other	76%

5.6 Results

5.6.1 Time to complete task

As was outlined in Chapter 4, participants were free to determine the total length of time they would take to complete the task, up to a limit of 15 minutes. Thus the overall time in minutes to complete the task varied from dyad to dyad. Table 5.6 indicates the mean time and range for the TD and DS/NSLD dyads.

Table 5.7: Mean and range of time to completion in minutes

dyad	n	mean (mins)	range (mins)
DS/NSLD	16	11	7 - 15
TD	16	13	9 - 15

A Mann-Whitney test indicated that any differences between the groups in terms of time to complete the task were not significant ( $z = 0.85$ ;  $p>0.05$ ).

5.6.2 Levels of engagement with the task

During the collaborative session, the level of each individual’s engagement with the task was coded under one of three mutually exclusive categories:

- on task (individually engaged)
- on task (collaborating)
- off task

The time each participant spent in each of the above states was calculated as a percentage of the time taken to complete the task. Mean percentages of the time spent in each state is represented for each group by pie charts in figures 5.1 – 5.3.

Figure 5.1 levels of engagement with task (DS)

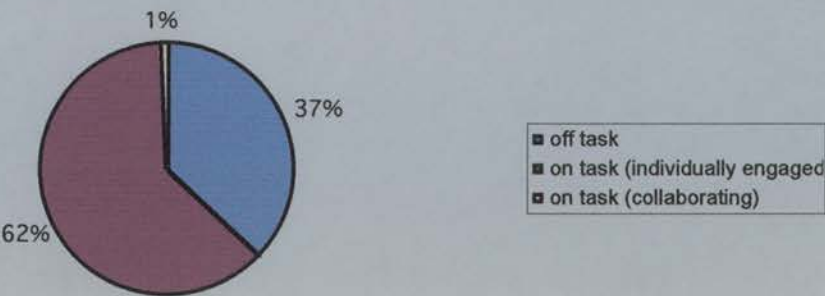


Figure 5.2: Levels of engagement with task (NSLD)

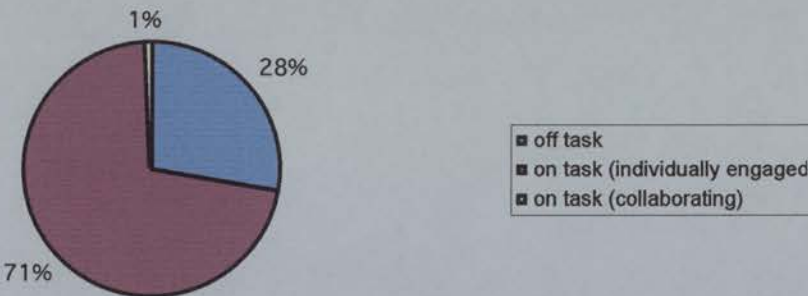
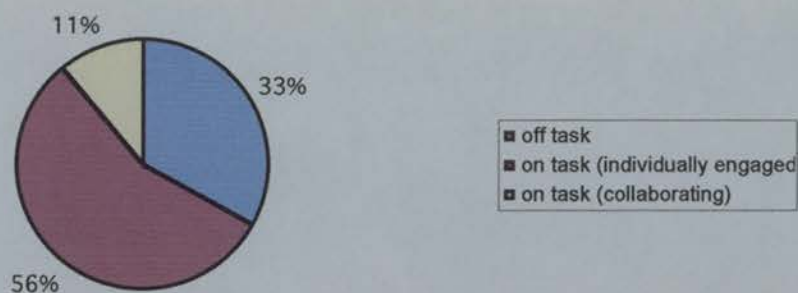




Figure 5.3: Levels of engagement with task (TD)



A Kruskal-Wallis test showed that no group differences existed in the percentage of time spent off task (Chi-square = 0.2; df = 2;  $p>0.05$ ) or in percentage of time spent on task, individually engaged (Chi-square = 1.9; df = 2;  $p>0.05$ ). However, there were group differences in the percentage of time spent collaborating (Chi-square = 6.6; df = 2;  $p<0.05$ ), with the TD dyads collaborating more than the DS/NSLD dyads.

**5.6.3 Speech**

*Amount of speech*

As dialogue is an important factor in the outcome of collaborative learning, it was important to determine whether group differences existed in the amount of speech produced. The total amount of speech produced by each participant was expressed as a ratio of the time taken to complete the task. Table 5.9 shows the mean frequency and SD of the time spent talking as a proportion of the total time to complete the task. A Kruskal-Wallis 1-way Anova indicated that group differences existed (Chi-square =

7.54;  $df = 2$ ;  $p < 0.05$ ). Mann-Whitney rank sum tests indicated that the main difference lay between the DS and TD groups ( $z = 2.39$ ;  $p < 0.05$ ), with the TD group spending more time talking during the task than the DS group did. There was no difference in the amount of speech produced between the DS and NSLD participants or between the TD and NSLD participants.

Table 5.8: Mean and SD of total speech ratio

	n	mean	SD
DS	8	2.89	7.14
NSLD	8	3.86	8.81
TD	16	5.81	6.57

*Categories of speech behaviours*

In order to obtain some measure of how varied was the speech produced by individual participants, each participant was scored for the number of categories in which they produced utterances. There were 21 possible categories of speech (see table 5.1). For the purpose of this analysis 3 categories were removed: off-task speech, speech directed to the researcher or speech which was categorised as ‘other’ e.g. incomplete or incomprehensible speech. Off-task was removed, as it was irrelevant to the task, while speech directed at the researcher was not related to the collaboration. The purpose of utterances that were coded as incomprehensible or incomplete could not be determined so these too were excluded. This left a possible 18 categories of speech. The mean and range of number of speech categories used by participants in any one collaborative session is shown in table 5.10. From this, it was apparent that the TD children produced

the largest variety of speech utterances and that the DS/NSLD group produced a more limited range of speech. Two participants did not produce any speech outwith the excluded categories: they were a male with DS and a male with NSLD.

Table 5.9: Mean and range of number of speech categories employed

	n	mean	range
DS	8	5	0- 10
NSLD	8	7	0- 12
TD	16	10	6- 13

An analysis of variance was computed and this indicated that group differences existed ( $F(2,29) = 6.1$ ;  $p<0.01$ ). A post-hoc Scheffé test indicated that the differences lay between the DS and TD groups. There were several categories of speech that were employed by both the children with NSLD and TD but not by the children with DS which might account for this. They were: reminders, rebuttals of offers of help, task-negative and task modification.

*Goal-directed*

As indicated earlier, goal-directed speech comprises commands, descriptive/procedural/planning statements, questions and reminders. Goal-directed speech was expressed as a ratio of the time to complete the task. The group mean and SD are given in table 5.11.

Table 5.10: Mean and SD of the ratio of goal-directed speech

	n	mean	SD
DS	8	0.91	0.92
NSLD	8	1.30	1.30
TD	16	1.97	1.00

From this it is apparent that the mean ratio is highest for the TD group with the children with DS producing on average less than the children with NSLD. A Kruskal-Wallis 1-way Anova indicated that group differences existed (Chi-square = 6.84; df = 2;  $p<0.05$ ) and a Mann-Whitney test indicated that this came mainly from the differences between the DS and the TD group ( $z = 2.27$ ;  $p<0.05$ ).

*Cognitive conflict*

Cognitive conflict is, by its nature, an internal process which cannot be measured as it occurs. However, certain types of speech are potential precursors to cognitive conflict in that they invite comparison of differing viewpoints. This category of speech comprised the following speech utterances: contradicting or disagreeing with the partner, pointing out mistakes in the children’s version of the model and lastly, using the target model as a point of reference. Each of these utterances indicate that the speaker has monitored the situation by comparing his or her own internal model of what the task entails, with either an alternative model (the partner’s) or a concrete model (the target model, which was available for inspection throughout the task). When the speaker disagrees with or contradicts the partner, they are clearly comparing the partner’s internal model to their own, either in terms of the appearance of the model or how the task should be best undertaken. When the speaker points out mistakes in the model or uses the target model

as a point of reference, they are comparing the children’s actual version of the model to the ideal version (the target model) and noting discrepancies. In each case, cognitive conflict is apparent in the sense that the child has compared an internal model or strategy to an external model and noted inconsistencies between the two. Table 5.12 shows the mean and SD of the number of utterances indicative of cognitive conflict expressed as a ratio of the time to complete the task for all 3 groups.

Table 5.11: Mean and SD of proportion of the ratio of speech indicative of cognitive conflict

	n	mean	SD
DS	8	0.40	0.65
NSLD	8	0.30	0.35
TD	16	0.65	0.43

A Kruskal-Wallis 1-way Anova indicated significant differences in the proportion of cognitive conflict utterances per minute (Chi-square = 6.6; df = 2;  $p<0.05$ ). Further Mann-Whitney tests indicated that in this instance, the difference lay between the NSLD and TD group ( $Z = 2.40$ ;  $p<0.05$ ).

### Facilitators

This category comprised utterances which facilitated collaboration between partners, either through giving positive feedback or encouraging the partner to express ideas. It consisted of the following types of speech: verbal agreement (a verbal statement of agreement with the partner’s ideas), offering to help when difficulty is noted, invitations for the partner to speak or encouraging the partner to give an opinion, and positive

personal comments about the collaborative partner. The total number of facilitators was expressed as a ratio of the time to complete the task. Table 5.13 indicates the mean and standard deviation of the ratio of facilitators by group. A Kruskal-Wallis 1-way Anova was computed to check for group differences and was found to be significant (Chi-square = 11.80; df = 2;  $p < 0.01$ ).

Table 5.12: Mean and SD of the ratio of facilitators

	n	mean	SD
DS	8	0.09	0.15
NSLD	8	0.08	0.13
TD	16	0.37	0.31

Mann-Whitney tests showed the differences to lie between the DS and the TD group ( $z = 2.6$ ;  $p < 0.01$ ) and the NSLD and the TD group ( $z = 2.9$ ;  $p < 0.01$ ).

*Task avoidance*

Task avoidance utterances consisted of excuses for not engaging with the task and requests to quit the task. In fact, only 2 children made excuses for not doing the task (one child with NSLD and one with DS) and only one TD child made a request to quit the task.

*Negative personal*

In some interactions there was a predominantly negative tone, directly evidenced by the amount of negative speech levelled at one child by the other. Negative personal speech

consisted of negative personal comments such as reprimands, insults, teasing, blaming and rebuttals of offers of help. Table 5.14 indicates the mean and SD of instances of negative speech in each group, expressed as ratio of the time to complete the task.

Table 5.13: Mean and SD of the ratio of negative personal speech

	n	mean	SD
DS	8	0.25	0.30
NSLD	8	0.82	1.01
TD	16	0.62	0.72

A Kruskal-Wallis 1-way Anova showed that there were significant group differences (Chi-square = 8.60; df = 2;  $p<0.05$ ). Further Mann-Whitney tests confirmed these to lie in the differences in proportion of negative personal speech between the DS and TD groups ( $z = 2.45$ ;  $p<0.05$ ), and the DS and NSLD group ( $z = 2.36$ ;  $p<0.05$ ). Thus the DS group used less negative speech than either the TD or the NSLD groups.

*Researcher-directed*

Researcher-directed speech included requests for help, requests for affirmation or praise and requests for information about the task. Again, this category of speech was calculated by counting the number of times individual participants used researcher-directed speech then expressing it as a ratio of the time to complete the task. Table 5.15 indicates the mean and SD of the ratio of researcher-directed speech for all 3 groups. A Kruskal-Wallis 1-way Anova checked for group differences. None were found (Chi-square = 4.46; df = 2;  $p>0.05$ ).



Table 5.14: Mean and SD of researcher-directed speech

	n	mean	SD
DS	8	0.25	0.7
NSLD	8	1.25	2.8
TD	16	1.0	1.0

*Off-task*

There is a substantial body of evidence to suggest that children with DS may attempt to distract attention away from difficult or challenging tasks through social means.

Accordingly, it was proposed that group differences might exist in the amount of off-task speech directed at the partner and the researcher. Table 5.16 shows the mean time and range spent off-task for each group, as a proportion of the total time to complete the task. It suggests that off-task speech featured frequently in some dyads but did not feature in others. No group differences were found when computed by a Kruskal-Wallis non-parametric Anova (Chi-square = 5.52, df = 2;  $p>0.05$ ).

Table 5.15: Mean and range of off-task speech per minute

	n =	mean	range
DS	8	20.22	47.53
ULD	8	16.56	42
TD	16	19.24	45

*Task negative*

Comments concerning the task which are negative in nature may be seen as an expression of frustration or they may be reflective of the fact that the participants believe that difficulties with the task are related to the task itself, rather than their own lack of ability. This type of utterance did not feature in the speech of the children with DS, and

featured in one child only in the group of participants with NSLD. It was, however, used by 9 out of the 16 TD participants.

### *Task modification*

On a similar note, some children would request to make their own version of the model instead of copying the target model. Invariably, this would occur when the children appeared to be struggling to copy the target model, or at points where they seemed particularly bored. The participants with DS in the study did not use this type of utterance and it was used by only 2 of the participants with NSLD. It did, however, feature much more often in the pairs of TD children, with 8 of the 16 children using such utterances. Of these 8 children, it usually appeared no more than once or twice in the course of the collaborative session. One child did however, produced 6 utterances in this category throughout that particular collaborative session.

### *Self-assessment of ability*

This was a category which involved children vocalising their thoughts on their own ability to do the task. In fact, very few children did so: only 2 of the children with DS, 3 of the children with NSLD and 4 of the TD children. Usually, this was a one-off occurrence and no significant group differences were seen when computed by a Kruskal-Wallis test ( $\text{Chi-square} = 1.34$ ;  $\text{df} = 2$ ;  $p < 0.05$ ). Table 5.17 shows the total number of times this type of utterance arose in each group. Comments were both negative and positive in both groups.

Table 5.16: Number of self-assessment of ability utterances

group	Participant 1	Participant 2	Participant 3	Participant 4	Total
DS	1	1	-	-	2
NSLD	2	4	6	-	12
TD	1	1	1	1	4

*‘Other’*

The category ‘other’ consisted of incomplete, inaudible or incomprehensible utterances and again was analysed as the number of such utterances expressed as a ratio of the total time taken to complete the task. There were no group differences in this category as measured by a Kruskal-Wallis test (Chi-square = 0.67; df = 2; p >0.05). However as table 5.18 indicates, on the whole, the mean is smaller for the NSLD group. It is unsurprising that the DS group should have a larger mean than the NSLD group, as children with DS are known to have problems with expressive language. The group which produced the largest ratio of such utterances was the TD group and perhaps was a reflection of the articulation problems of pre-school age children.

Table 5.17: Mean and SD of ‘other’ category

	n	mean	SD
DS	8	0.4	0.5
NSLD	8	0.3	0.2
TD	16	0.5	0.4

#### 5.6.4 Non-verbal behaviour

##### *Eye contact*

It is known that children with DS exhibit deviant gaze patterns (Berger, 1990) and as gaze is thought to be an important factor in engagement, particular attention was paid to eye contact in the three groups of children. Continual glancing to another person may also be indicative of an outer-directed approach to learning (Bybee & Zigler, 1998). Eye contact was measured in several ways: the number of times a participant glanced at his or her partner, the duration of time spent gazing at the partner, number of times joint eye contact was made and the duration thereof.

There were no group differences apparent in terms of the number of times participants glanced at their partner when the data were subjected to a Kruskal-Wallis 1-Way Anova (Chi-square = 0.10; df = 2;  $p>0.05$ ) or in the duration of time spent looking at the partner (Chi-square = 0.25; df =2;  $p>0.05$ ).

As joint eye contact occurs between pairs of children, it could only be determined whether group differences existed between the DS/NSLD group and the TD group. Mann-Whitney tests concluded that there were no differences between the TD and the DS/NSLD groups in terms of the number of times joint eye contact was made between dyads ( $z = 0.48$ ;  $p>0.05$ ) or the duration thereof ( $z = 0.48$ ;  $p>0.05$ ).

*Physical conflict*

In some dyads there was clear physical conflict between the participants, characterised by snatching, blocking access to the board or bricks or physically preventing the partner from placing bricks. Actual instances of conflict were computed. As table 5.19 shows, the mean amount of physical conflict evidenced was similar for each group. This finding was substantiated by a 1-way analysis of variance ( $F(2,29) = 0.15; p > 0.05$ ).

Table 5.18: Mean and range of number of instances of physical conflict

	n	mean	range
DS	8	0.75	0- 4
NSLD	8	1.25	0- 6
TD	16	1.06	0- 7

In addition, a Pearson correlation was calculated to determine whether the number of instances of cognitive conflict correlated with instances of physical conflict. No correlation was found ( $r_s = 0.9; n = 32; p > 0.05$ ).

**5.6.5 Possible correlations between behaviours measured and pre- to post-test outcomes**

As well as determining whether group differences existed, it was of interest whether any of the behaviours measured during the collaborative sessions would correlate with changes in score from the pre- to the post-test. Certain behaviours were deemed to be more likely than others to influence positive outcomes. Accordingly, Spearman rank correlations were computed to determine whether the amount of facilitators was

correlated with pre- to post-test change, but was not found to be significant ( $r_s = 0.12$ ;  $p > 0.05$ ). Neither was there a correlation between the amount of time spent in collaboration and pre- to post-test change in score ( $r_s = 0.16$ ;  $p > 0.05$ ) or the total amount of goal-directed speech and pre- to post-test change in score ( $r_s = 0.10$ ;  $p > 0.05$ ). There was also no correlation between the group of speech behaviours indicative of cognitive conflict and pre- to post-test change ( $r_s = 0.2$ ;  $p > 0.05$ ). However, when computed as a behaviour in its own right, references to the target model was significantly correlated with more successful outcomes ( $r_s = 0.4$ ;  $p < 0.05$ ).

## **5.7 Discussion**

### **5.7.1 Group differences in performance**

In terms of group differences, a main consideration was whether the children with DS differed from the other groups of children with regard to their social behaviour within the dyad and their approach to learning. There is previous evidence to suggest that the presence of a partner may be a distracting factor to children with DS (Kasari & Freeman, 2001) as they may experience problems in switching between the social and cognitive aspects of the task, and instead will show a preference for focusing on the partner. The results of Study 1 indicate that this is not the case: children with DS did not generally focus on the partner to the detriment of the task.

There were also no group differences noted in terms of the amount of time spent off-task for any group. This may provide further support for the suggestion of Ruskin and colleagues (1994a, 1994b) that children with DS may actually be more focused in the

presence of a partner. The presence of a peer may indeed be a positive feature in that it was noted that when one child went notably off-task, he or she would often be reprimanded by the partner and brought back to the task. In some ways, a peer partner may be more effective than an adult at keeping a child on-task as there is the element of shared responsibility for the task. The fact that the range of time from commencement to finish of task is similar for both groups of children (TD and DS/NSLD) may seem unsurprising given that an upper time limit was imposed. However, there was little to suggest that many of the dyads would have gone over the fifteen minutes limit. Dyads who were approaching the upper limit had often gone off-task some time beforehand. Consequently, differences in time tended to be due to factors such as how much time the children spent off-task or whether they decided to de-construct then subsequently re-build their version of the model after deciding it was incorrect.

Wishart and colleagues have suggested that children with DS may attempt to evade a task when it becomes challenging and that one way to do so is through the misuse of social skills. Had this been the case, we might have expected to see more off-task speech as the child with DS attempted to engage the partner. In fact, there were no group differences in the amount of off-task speech. Other indicators of attempts at task evasion may have been the number of excuses made to avoid engaging with the task or the numbers of requests the child made to quit the task. In fact, there was only one request to quit, which came from a TD child who had been tested in a nursery where experimental research was common.



Only three participants made excuses for not engaging with the task: two participants with DS and one with NSLD. This makes it difficult to comment on group differences. TD children may have had slightly more sophisticated methods of task evasion as reflected by the finding that task modification statements came mainly from the TD children. It was seen less often in the group of NSLD children and not at all in the group of children with DS. Requests to construct a different (usually easier) version may be seen as a legitimate way of evading a task that is perceived to be too challenging. And indeed, it may be thought of as a more constructive approach to the task in hand in that the child recognises a mismatch between the task level and his or her ability to complete it. Instead of quitting the task, the child asks that the task be modified to better suit his or her ability.

Related to this may be a tendency to either internalise or externalise any difficulties the child experiences with the task. The group of TD children was the only group to make negative comments concerning the task. Comments such as "Boring, horrible house" might be a way of externalising frustration with the difficulty of the task to the task itself. Such utterances may be indicative that the children who make such utterances believe the problem to lie with the task itself, rather than with their own inability to complete the task. This type of comment was used much less often by the group of learning-disabled participants which suggests that they may have been more inclined to believe that difficulties with the task were due to their own lack of ability. This would hardly be surprising given the older average age and likely history of frequent learning

failure in the children with learning disabilities. One comment made often by the TD children was that the task was “too difficult for children my age”, thus absolving themselves of any responsibility for their subsequent failure at the task.

Zigler (1984) proposed that because children with learning disabilities fail more often on intellectual tasks, they look to others for solutions wherever possible and this leads to a more outer-directed approach to learning. This may be particularly true of children with DS as they have been shown to exhibit low levels of mastery motivation (Vietze et al., 1983; Ruskin et al., 1994a). Lower levels of motivation to master a task may be indicated by a reliance on the adult observer and consequently utterances directed towards the adult observer were measured in this study. Of particular interest was whether the group of children with learning disabilities made more requests for either affirmation or praise which would indicate a need for external reward. No group differences were noted for this, and in fact few such utterances were made overall. It could be that the presence of the peer partner had a sufficiently reinforcing effect on the efforts of the child with DS. It was noted however, that in dyads where the interaction was not going well that the children glanced to the researcher often, as if looking for reassurance or guidance. Due to the angle of the video-camera, this could not be accurately measured, however, and so could not be further analysed.

The quantity and type of speech employed is thought to be an important factor in determining whether peer collaboration is successful or not (Bearison et al., 1986;

Teasley, 1995; Ellis & Gauvain, 1992). The results from Study 1a have indicated group differences both in terms of the type and quantity of speech produced. The total amount of speech produced per participant varied across groups with the TD children speaking most and the children with DS speaking least. This is consistent with Landry and colleagues' (1998) finding that children with DS make significantly fewer verbalisations than TD children in a joint play activity. This finding may be related to the fact that children with DS have well-documented problems with expressive language and articulation (e.g. Miller, 1988; Stoel-Gammon, 1997). This may have contributed to a reluctance to speak out. Related to this is the finding that children with DS and NSLD tended to use fewer categories of speech than did the TD children. Thus the speech of the NSLD and DS participants may be less flexible than that of the TD participants, or equally it might be related to some of the language difficulties commonly seen in children with DS. Problems with expressive language and in particular expressive syntax might mean that children with DS tend to use a restricted number of speech categories. Both these findings may relate to the slightly poorer outcome of collaborative learning seen in the children with NSLD. If children with DS do not verbalise their opinions as often as they might, it may make for a less constructive collaborative experience for the partner.

In terms of speech specifically concerned with the task, the children with DS were shown in this study to use less goal-directed speech than the TD children did. Goal-directed speech consisted of descriptive statements, questions and reminders to the

partner of what the goal of the task entailed. Goal-directed statements may therefore be a measure of how much responsibility the child feels for the completion of the task.

Children who feel that the task is not equally their responsibility are perhaps less likely to use such statements. As a group, the children with DS did not in fact use significantly less goal-directed speech than their partners. However, the finding that in some dyads, the NSLD partners used much more of this type of speech may be related to how each member of the dyad viewed his or her role. During informal viewing of the videotapes, it was noted that the child with NSLD often automatically assumed the role of teacher. Many of them remarked either after or during the session, how difficult it had been to 'teach' the child with DS or how they had done well 'helping' the child with DS. This is interesting given that this had not been introduced as a concept by the researcher and the fact that the children were of a similar ability level. This pattern may in some way have been reinforced by the children with DS as it was noted that one of the categories within which children with NSLD and TD children scored but children with DS did not was rebuttals of offers of help. It seems then that children with DS may be less assertive about their ability to tackle problems independently and may be more passive when another child intervenes. Such results are consistent with data collected on infants with DS by Wishart (1990, 1991, 1993a) which showed that infants with DS may relinquish control of a task more quickly than TD infants and may be more passive.

The finding that there were no group differences in the category 'other' suggests that children with DS were not less significantly less comprehensible in their speech than

other groups. However, it is acknowledged that the control group of TD were, on the whole, aged 3 to 5 years, and that children in this age range are more likely to produce incomprehensible or incomplete utterances than older children. It should also be noted that utterances were coded as incomprehensible only if the video rater was unable to comprehend them. The video-rater was relatively familiar with the children who participated in the study and also had the benefit of being able to re-play any utterances which were not immediately comprehensible. Thus, it is possible that speech which did not ultimately come under the category of 'incomprehensible' might not have been wholly comprehensible to peer partners who were experiencing the speech 'on-line'.

Gaze patterns between the children were given particular attention in analyses, as previous research had suggested that children with DS might have problems interacting due to their abnormal gaze patterns. There were, however, no group differences in terms of the number of occurrences of, or duration of, joint gaze. This finding is concordant with Sinson and Wetherick's (1981) finding that abnormal gaze patterns are found more commonly in children with DS when interacting with a TD child. When the interaction is with a child with learning disabilities of another etiology, abnormal patterns no longer occur. This strengthens the proposal that children with learning disabilities may be able to act as suitable partners for other children with learning disabilities. While a TD child may confer benefits in terms of their superior ability, this advantage must be weighed against the possibility that an interaction between a TD child and a child with learning disabilities may lead to difficulties in terms of the more social aspects of the exchange.

### **5.7.2 To what extent did collaboration occur?**

Examining the extent to which children who work together are in fact collaborating is dependent upon the definition of collaboration that is used. All too often, in studies of collaboration, there is no real assessment of the extent to which the children are working in collaboration with one another and the extent to which they may be considered to be engaged with a task in parallel. A definition of collaboration could be two individuals working reciprocally towards the same goal. Two individuals may work together reciprocally in the sense that they interact in a positive manner and encourage one another. If a more conservative definition of collaboration is used, we may want to consider the actual time spent working independently on the same part of the model with the same implicit goal. When this was taken as a proportion of the overall time spent on the task, it was apparent that the TD dyads spent more time actually collaborating than did the group of learning-disabled dyads. In other words, the learning disabled group spent more time working on separate parts of the model. However, it should be noted that the vast majority of dyads in the study did not show any instance of collaboration when defined as working on the same part of the model. In fact, only 2 of the 8 dyads of children with learning disabilities and 4 out of the 8 dyads of TD children showed such behaviour.

This result is perhaps not surprising given the young age of the TD children and the literature which suggests that younger children do not yet have the social skills to collaborate effectively with each other (Strayer & Trudel, 1984). In terms of the learning disabled children, one would have perhaps expected the older children to have more

advanced social skills and as a result, to have been better able to sustain a collaborative interaction. However, in this study it appeared that some of the older learning-disabled participants were uncomfortable with the collaborative format and were uncertain of how to react to their partner during the collaboration.

While this interpretation seems to suggest that many children who appeared at first glance to be collaborating were, in actual fact, working in parallel is perhaps an unnecessarily pessimistic conclusion. The original definition of collaboration in the video coding was restricted to when both partners worked together on the same part of the model (see Appendix G). However, if a broader definition of collaboration is taken, we might consider any behaviour to be collaboration which facilitates interaction and ultimately the task goal. It should be remembered that the main aim of collaboration is to improve understanding in both partners. This may come about in instances where partners actually appear to be working in parallel or even in instances where one child appears not to be engaged. For example, it was frequently noted that when one child was engaged with a particular part of the model, the other child was often keenly observing. In this way, children may be inferring strategies from the performance of the other child. We have already noted that although children with DS showed less goal-directed behaviours and spoke relatively infrequently, they often made utterances that could be considered indicative of cognitive conflict. Thus, although participation in the task appeared to be minimal in some cases and truly joint working the exception, there is evidence to suggest that cognitive processing is occurring on an internal level.



The ability to work together reciprocally and take into account the presence of another is one of the major tenets of the neo-Vygotskian approach to collaboration. While there was often little evidence that both children had worked together jointly on a single part of the model, in many dyads there was an overall positive atmosphere and a feeling that both children were working jointly towards a single goal. Often the positive interaction was promoted by certain behaviours which were analysed under a single grouping called facilitators. Facilitators included behaviours which served to make the interaction more constructive (such as positive personal comments) or which served to draw the partner into the interaction and strengthen the notion that the task was a joint task (such as invitations to comment). It was found that the TD group tended to use much more of this facilitative type of speech than either the DS or NSLD groups. This is perhaps surprising, considering the young age of the TD children involved. However, it may be related to the fact that the TD children attended nursery schools where they were in close proximity with each other for most of the day, while the learning disabled children attended the equivalent of primary or secondary school classes and were often in different classes for all or part of the school day. The tendency to use this very facilitative type of talk may therefore be related to how well the children know one another. It may also be related to the amount of collaborative work the children have been exposed to beforehand. Group or joint work is not a common feature of classes of learning disabled children and children in separate provision may simply have less experience of working in collaboration with a peer.

Despite this, there were nevertheless a few TD dyads for whom the joint session had had an obviously negative undertone and although the children may have been familiar, there was no rapport between them. Negativity within the dyad was measured by the amount of negative speech levelled at one child by the other and by rebuttals of offers of help. The DS group showed the least amount of negative speech towards their partner, while the NSLD group showed the most. This finding may be related to the fact that many children with NSLD assumed a superior role to their DS partner and in some cases, this led to a fairly patronising attitude.

### **5.7.3 Does cognitive conflict have a role to play in positive outcomes?**

While the neo-Vygotskians emphasised the role of reciprocity, researchers influenced by Piaget have emphasised more the role of cognitive conflict. In this analysis, cognitive conflict was measured by the number of utterances which were related to either defending a viewpoint or disagreeing with a partner's point of view, or pointing out discrepancies between the actual model and the target model. There were group differences in this category of analysis and these were found mainly to be between the NSLD and TD groups. The TD group produced the largest mean number of such utterances, followed by the DS group, with the NSLD group producing the least. The amount of such utterances produced by the DS group was not significantly different to the TD group. This is particularly interesting given that the participants with DS produced the least speech overall. One interpretation of this is that although the participants with DS may have appeared to be participating less in the task in the sense that they rarely used general task-related speech, they were nevertheless engaged at the

cognitive level and noted discrepancies between either their own point of view and their partner's or between the target model and the children's model. Such utterances may therefore have been indicative of a monitoring and on-going processing of the task progress. These factors may also be related to the improvements seen in the group of children with DS, as defending one's own point of view or disagreeing with the partner's view may be a prerequisite for cognitive change.

Howe has suggested that while socio-cognitive conflict is useful in terms of learning, it may also lead to aggressive behaviour (Howe & Tolmie, 2001). This was not the case in this study as no correlation was found between cognitive conflict speech and acts of physical conflict. Even the limited number of instances of snatching and blocking access to the Lego bricks might not perhaps have been indicative of real aggression in the present study. They may instead simply reflect a fairly normal form of interaction in younger TD children and children with lower cognitive abilities.

#### **5.7.4 Which behaviours correlate with outcome?**

The only behaviour which was shown to correlate with outcome was the number of times the participants used the target model as a point of reference. This behaviour may have been particularly effective in promoting positive outcomes for a number of reasons. Firstly, drawing attention to inconsistencies between the target model and the children's version draws both children into a 'joint space' where both are considering the same problem simultaneously. This type of interaction is perhaps more likely than others to lead to shared dialogue. Secondly, comparing the ideal version with the children's

version is likely to lead to cognitive conflict as both children are made aware of the inconsistency in their own model. Other utterances in the cognitive conflict grouping may not have had this dual benefit. For example, pointing out mistakes in the children's version of the model may invite the partner into a joint dialogue but it does not directly compare the children's version to the correct version. Similarly, disagreeing with the partner may be a precursor to cognitive conflict but only if the child thereafter explicitly details why they believe that they are correct. If the child simply contradicts or disagrees with the partner, the partner may stop to reflect on their own beliefs, or they may simply choose to ignore the criticism, thus missing an opportunity to compare two conflicting viewpoints.

## **5.8 Overview**

The results from this more qualitative analysis of collaborative sessions in study 1 reinforce the results from the quantitative analysis which suggested that peer collaboration could be a useful forum for learning in children with DS. The fact that there was little off-task behaviour or task evasion is commensurate with previous research suggesting that joint participation with a partner may help children with DS to focus. It was noted informally, that the children with DS who simply repeated the task three times had to be prompted by the researcher far more often than the children who had worked with a peer partner. The presence of the peer partner perhaps also made the child participants less focused on the adult researcher.

The literature on collaborative learning in children with learning disabilities relies heavily on the tutoring paradigm, assuming that same ability children may have nothing to offer each other in the way of aiding cognitive advancement and implying a need for a partner who is more advanced. This is reminiscent of the view that was strongly held in mainstream psychology until the emergence of paradigms involving peer collaboration: that children better learn from adults. In some ways, another learning-disabled peer may be seen to be the ideal partner for a child with learning disabilities, as the child may be more likely to feel more comfortable and more able to express opinions that contradict those of the partner. This is less likely to be the case with a TD child or an adult where a perceived asymmetry in either status or ability might block reciprocal interaction. One advantage that TD children would seem to have in contrast is their tendency to facilitate the interaction through verbal and social means. This is perhaps an aspect of collaboration that comes with practice.

In terms of the theories underpinning the mechanisms of collaboration, the unstructured nature of the collaboration in this study prevents us from drawing any definite conclusions. However, there is some indication that cognitive conflict as proposed by the neo-Piagetians, and the role of reciprocity and co-operation, as proposed by the neo-Vygotskians, may both have a role to play. Observations of the video-tapes strongly suggested that dyads with a more co-operative atmosphere were likely to fare better than those dyads in which it was apparent that there was no rapport between the individuals. One of the possible reasons for this is that a tense, uncomfortable atmosphere may not

be conducive to talk and may deny the participants the chance to process their own beliefs. In this study, there was some evidence to suggest that cognitive conflict does indeed play a role in promoting positive outcomes. However, it is also likely that more social factors such as promoting a positive working environment also play a role.

In summary, it appears that collaboration with a learning-disabled peer can be a useful learning platform for children with DS, given conducive circumstances. The content and nature of speech between partners is also likely to have an important role to play in outcomes in such collaborative contexts.

## **CHAPTER 6**

### **CONSERVATION TASKS AS A BASIS FOR PEER COLLABORATION**

#### **6.1 Implications of Study 1 for Study 2**

Whilst the results of Study 1 were encouraging, in that some participants appeared to benefit from collaborative interaction, a number of qualifying points need to be made. Firstly, the results indicated a wide variation in individual outcomes, even within the different groups of children, making it difficult to draw strong conclusions about group differences. It is likely that the large variation in outcome seen may be partly attributable to the unstructured nature of the task. An unstructured task carried out without significant external guidance was necessary, in order to make inferences about how the contrasting groups of participants behaved in interaction with other children, but it meant that parity of conditions was difficult to achieve across individual pairs of children. This means for example, that children with a propensity to go off-task would do so and while this information was useful in terms of examining how likely different groups of children were to go off-task in the presence of another child, it meant that it was difficult to comment on the overall effectiveness of collaboration, as conditions could be very different from dyad to dyad. For these reasons, it became apparent that Study 2 should follow a more structured format which would afford the participants less opportunity to go off-task.



A second difficulty, which arose from the unstructured nature of the task, was that there was great variation in the amount, quality and content of conversation produced within dyads. In some dyads there was no speech at all, while in others there was almost constant speech throughout. As the amount and quality of speech produced is thought to be a determining factor in the effect of collaboration on outcome (e.g. Ellis & Gauvain, 1992; Teasley, 1995) the variability in terms of speech produced again meant that it was difficult to comment on overall group differences. A task which specifically encouraged on-task speech was therefore sought.

Whilst the results from Study 1 indicated that some children with DS were able to benefit from joint problem-solving with a partner on simple construction tasks the results for the group of children with NSLD were less encouraging. The lack of improvements seen in this group may have been partly attributable to the effect of having a child with DS as a partner, however, and the design of Study 1 makes it difficult to disentangle the effects of collaboration on participants and the efficacy with which participants acted as partners. For this reason, the design of Study 2 needed to consider the effect of collaboration on both groups of children, whilst controlling more tightly for the effect of the partner. From the above it can be surmised that for Study 2 a task was required that:

- was conceptually-based, thereby minimising the possibility of practice effects or underperformance;

- encouraged verbal interaction and the vocalisation of thought processes;
- provided enough structure and interest to prevent off-task behaviours;
- controlled for the effect of partners, allowing group differences in collaboration to be more clearly examined.

Conservation tasks seemed to be the ideal basis for Study 2, having already been a popular choice for research on collaborative learning in the typically-developing literature. Part of their appeal is that improvements in performance in understanding of conservation are relatively clear cut and also reflect a change in conceptual thinking. Traditionally, collaboration around conservation tasks has comprised a fairly structured task with an emphasis on encouraging the participants to verbally justify his or her answers which may, in turn, lead to further discussion. Conservation tasks are especially suitable for children with learning disabilities, as many researchers have emphasised the importance of Piaget's notion of sequences and structures for the assessment of children with learning disabilities. Woodward (1979), for example, has noted that although children with learning disabilities often fall below floor on standard intelligence tests, conservation tasks suit a wide range of ability. Many conservation tasks also allow the participants to manipulate the materials thus affording hands-on experience. Inhelder (1968) noted that conservation tasks hold the child's interest whilst making minimum demands on acquired knowledge or memory. The next section discusses the conceptual basis of conservation attainment in more detail in order that a clear rationale for Study 2 may be provided.

## **6.2 The developmental significance of the attainment of conservation**

Conservation may be described as the ability to realise that certain attributes of an object (for example, number, weight, volume or length) are constant even when that object is transformed in shape or superficial appearance. The first principles of conservation, namely the invariance of the shape and dimensions of solid objects, are mastered fairly early on, at approximately the end of the first year in TD children (Inhelder, 1968), but there are other aspects of conservation which are more complex. If the object has been subject to transformations (such as rearrangement of its parts, or dividing it), it is difficult for the younger child to determine whether the object has actually changed in terms of number, matter, or volume, or whether the transformation has merely affected the perceptual appearance of the object. For example, when liquid is poured from a short fat container into a tall, thin container, its volume remains constant although its appearance may be strikingly different.

Conservation attainment has clear links to developmental ability and in particular the ability to think logically. As discussed in Chapter 1, implicit within Piaget's stage theory of development is the idea that the ability to think logically is attained gradually as the child matures. He proposed that this progression in logical thinking will lead a child to the attainment of conservation of number, followed by matter, then weight, then volume and finally to a generalised notion of the conservation of quantity. True conservation requires a grasp of 3 concepts: compensation, reversibility and identity. Piaget (1950) believed that one of the most pronounced characteristics of pre-operational thought is

the tendency to centre on a striking feature of the object while neglecting other features and in doing so to reason illogically. Pre-operational children cannot, for example, co-ordinate both the length and the cross-sectional area of an object at the same time. As well as being unable to attend to two relevant dimensions at the same time, pre-operational children cannot relate two dimensions in a logical manner. This ability to relate different attributes of an object in a logical sequence is known as compensation. For example, in the case of two equal rows of counters, when one row is bunched together the conserver understands that a reduction in length may be compensation for by an increase in density. The child that understands this has noticed both attributes and has an understanding of how each affect the other. Another salient feature of the conserver's thought is reversibility (Piaget, 1977a). Cognitive organisation may be considered to be reversible if it can follow a chain of interlinked events then reverse directions to arrive back at the original state. Thus the row of counters that were bunched together may be separated out again to change the density of that row and restore it to its original length. Finally, the conserver understands identity and can reason that an arrangement, irrespective of how it appears, must contain the same amount as long as nothing is added or taken away.

### **6.3 A universal sequence**

As we have seen Piaget proposed that the development of operational thought is the basis for conservation of number, matter, weight, and volume and leads finally to a generalised understanding of the conservation of quantity (Flavell, 1963). This sequence

of conservation attainment appears to be universal and progresses in that order, even in the face of experimental intervention designed to speed it up (e.g. Smedslund, 1968; Tomlinson-Keasey, 1978). The universality of the sequence is enduring also for children with learning disabilities (Piaget & Inhelder, 1974; Weisz, Yeates & Zigler, 1982).

Inhelder (1968) noted that although children with learning disabilities were not a homogenous group in terms of disability, age etc, their reactions in the test situation were homogenous. Specifically, their reasoning was analogous to that of much younger TD children. The children in Inhelder's study were seen to present the same judgements and reasoning as those found in TD children between five and seven years of age. As with these younger TD children, older children with learning disabilities showed a primacy of perception over intellectual operations. In other words their explanations of their conservation judgements were based on appearance rather than any logical reasoning.

In terms of the difference versus developmental debate few differences in conservation attainment have been noted between children with an organically-based learning disabilities such as DS and those with a learning disability for which no organic cause is known (e.g. Cicchetti & Mans-Waegner, 1987; Cicchetti & Sroufe, 1976, 1978). The similar sequence hypothesis would predict that children with DS would show the same order of acquisition of conservation concepts as TD children, while the similar-structure hypothesis would predict that once an individual with DS had reached a certain

developmental stage, their performance should be comparable with TD individuals at the same cognitive level.

With regard to conservation concepts, it appears that children with DS progress through the same sequence of stages as TD children (Lister et al., 1988). However some studies based on Piagetian concepts have presented a challenge to the similar-structure hypothesis. Lister and colleagues found that some children with DS conserved substance, weight and volume at mental ages lower than those seen in conserving TD children. Although understanding of conservation is attained at relatively high developmental ages (between 4 and 6 years for number (McGarrigle & Donaldson, 1974), and between 7 and 8 years for matter (Piaget & Inhelder, 1974), this does not preclude them as suitable tasks for children with learning disabilities.

Conservation of number and conservation of matter were chosen to be the basis of Study 2 as they are two of the earliest stages in understanding of conservation and are therefore most suitable for children of lower developmental ages. The next sections outline in more detail what is meant by the conservation of number and matter and how each may be assessed. Conservation of number is always attained first, followed by conservation of matter. In addition to this, the progression from non-conservation to conservation is a gradual process: a transitional stage may be identified where children conserve under some circumstances but not others. Accordingly, the taxonomy that follows splits both

conservation of number and matter into 3 stages: non-conservation, intermediate conservation and conservation.

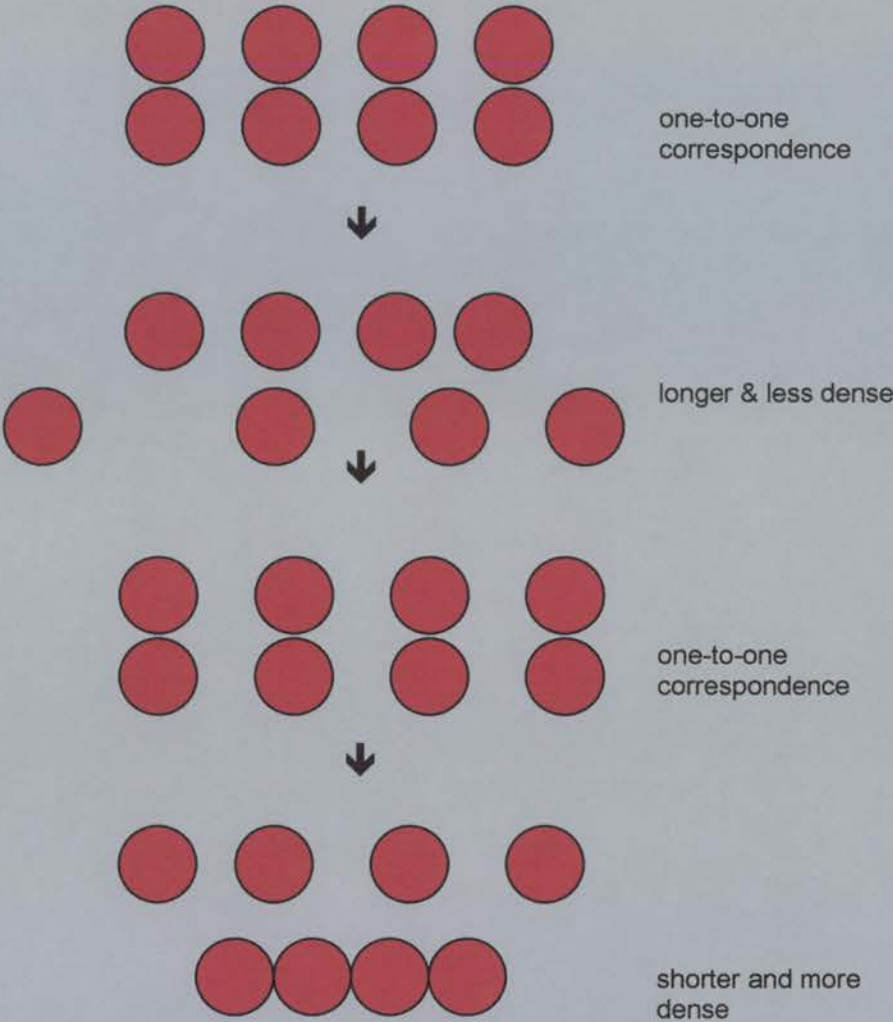
#### **6.4 Conservation of number**

Conservation of number may be described as the understanding that number is an invariant and thus does not change, no matter how it is superficially transformed.

Number conservation has typically been assessed in experimental situations by showing a child an equal number of objects, such as two rows of four buttons spread out in one to one correspondence (see figure 6.1). One row is then transformed in perceptual appearance, for example by pushing the buttons in one row closer together to make the row appear shorter. The child is asked to judge whether the number of items in both rows is equal in the original display and then in the transformed display. The child is also asked to justify his or her judgement, that is, to explain why it is believed that the numbers are equal or unequal. In such experimental situations, number non-conservers believe that the quantity has changed as soon as the appearance of an array is changed. Thus as soon as the line of buttons is altered, the child thinks that the quantity has either increased or decreased. This is an indication that the child estimates quantities merely from perceptual appearances.



Figure 6.1 Conservation of number sequence



Piaget (1952) found that the majority of under-fives could not conserve on this task. However, McGarrigle & Donaldson, (1974) demonstrated that younger children may be able to conserve number if the task is more appropriately contextualised. McGarrigle and Donaldson believed that the form of questioning used in the classic form of the task influenced the responses the children made. Donaldson (1978) proposed that children bring expectations and prior knowledge to every situation and therefore that the child's interpretation of the adult's words will be affected by their expectations. In everyday life, when adults ask children a question it is not usually to learn the answer, it is to test the child's knowledge about a situation. Thus the children in the classic task believed that there must be some significance attached to the fact that the adult had moved the buttons before asking whether there was still the same number in each row, otherwise the adult would not have asked the question.

To remove the need for the adult to change the array, McGarrigle and Donaldson introduced a 'naughty teddy'. The children were told in advance that, at some point during the session, the teddy might mess up the display. When the 'naughty teddy' effects the change, it is obvious to the children that the change is accidental and they no longer connect the adult's question with the move. They tested eighty children aged between 4; 2 and 6; 3 years on both conservation of number and length tasks using a standard version (intentional transformation) and an 'accidental transformation' task (in which the teddy messes up the display). They found that 71.9 per cent of the responses were correct when the display was moved 'accidentally' by the teddy, whereas only 33.7

per cent were correct in the intentional transformation condition (or classic Piagetian procedure). These experiments suggest that the young child's ability to conserve might have been greatly under-estimated and that younger children may, in fact, have a better grasp of conservation than was previously thought. The next sections will now consider in more detail stages in the attainment of number conservation.

#### **6.4.1 Stage I: Absence of the conservation of number**

As stated above, number non-conservers base their judgements on the perceptual appearance of the display of objects, for example believing that a spread out row is greater in number than a bunched together row. The child may be aware at some level that the buttons in each set are equal, as the examiner initially put them out in one-to-one correspondence or the child may actually have counted them in the beginning. Although this may be considered a practically correct enumeration, it is still not enough for conservation. The child relies more on perceptual evaluation than on one-to one correspondence and even on actual counting. The child only grasps the fact that the two sets are equal as long as they are in lines of equal length. As soon as the shape of one is altered, it is no longer considered to be equal in number.

In addition to a reliance on perceptual appearance, the child is unable to co-ordinate perceptual changes. For example, the number non-conserver cannot see that an increase in length is compensated for by a decrease in density. This lack of co-ordination explains the contradictory answers that the number non-conserver gives. The child assumes that a

set with the same number of items may be made into a set that has more. This is true mathematical non-conservation.

At the stage of complete non-conservation there is no conflict between perceptual appearance and rational operations as quantification is so under-developed that perceptual appearance overrules it completely. Underlying this is Piaget's (1952) assertion that when a child at this level is requested to count, the counting is only verbal recitation. Similarly, one-to-one correspondence at this stage is not a quantifying operation; it is nothing more than a qualitative comparison.

#### **6.4.2 Stage II: Intermediate conservation of number**

In the stage of intermediate number conservation, two occurrences appear which are not seen in the first stage. The first is conflict: in the intermediate stage of number conservation there is a conflict between the one-to-one correspondence of the items and their perceptual appearance (i.e. the child knows them to be the same as he or she has counted them, but the fact that one line looks longer than the other suggests that the longer line has more). Secondly, as a result of the conflict the child co-ordinates the perceptual relations and uses these to justify his or her judgement. So for example, a child might say "That one's got more, because that one's big and that one's small" (indicating the length of a row). The child will continue to maintain that the amount changes when the appearance changes, but will nevertheless maintain that there is the same amount in each set. Hence there is conservation when the child is thinking about the row of discontinuous elements and non-conservation when he is thinking of one or

the other dimensions of the set as a whole. The child will sometimes conserve if the change is small, but will fail to conserve following a more noticeable change (e.g. if one row is stretched out to be really long). When the rows are equal the child is able to conserve. However, when one is transformed, the child's belief is shaken by the perceptual appearance. The main difference between the non-conserver and the intermediate conserver is that, while the non-conserver's belief in equivalence is destroyed as soon as a transformation takes place, the intermediate conserver will state conflicting opinions. So while the child states that one row has more buttons than the other, when asked how they would look if returned to their pre-transformation state, he or she will answer that they would have the same number of buttons. The child can only begin to reconcile these differences in thinking by co-ordinating the relations in question, for example realising that a decrease in length will be compensated for by an increase in density.

#### **6.4.3 Stage III: Attainment of the conservation of number**

In the third stage, the child no longer needs to mull over the problem and there is no conflict: the child understands conservation as a matter of course. The child who is just entering the concrete operational stage will count the buttons each time and then say the number is the same. The conserver does not need to count the buttons to assert the constancy of the original number as long as no buttons are added or taken away. It could be argued that the conserver has done so simply by overcoming the perceptual factors (i.e. he or she is no longer seduced by the appearance of the rows), yet the arguments used to justify an answer show that the essential factor in number

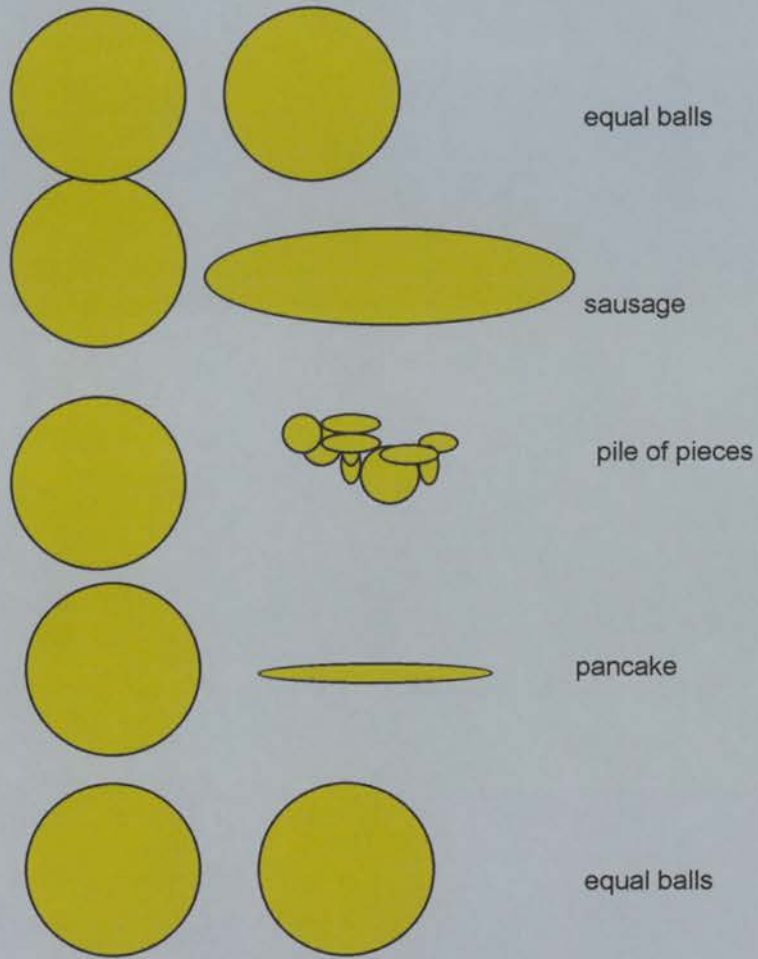
conservation is the co-ordination of relations. For example, the child is able to understand that any increase in length will be compensated for by greater spaces between the buttons.

The child is now able to perform inverse operations because the transformations, previously considered to be mere perceptual changes, have become operational. The child grasps that any change may be reversed. The conflict between perception and correspondence that was discernible in the second stage comes to an end, with correspondence triumphing over perceptual appearance. In other words, although the perceptual appearance of the array suggests otherwise, the child is able to hold in mind the fact that the amounts were, in fact, equal to begin with.

## **6.5 Conservation of matter**

The technique to be used for assessing understanding of the conservation of matter in Study 2 was adapted from the original technique set out by Piaget and Inhelder (1974). Each child is given two equal balls of a material such as clay and is asked to assert whether both balls contain the same amount of clay. Once the child is convinced that the two balls contain equal amounts of clay he or she is asked to take one of the two balls and to make it into a sausage or a pancake or small pieces (see figure 6.2).

Figure 6.2 Conservation of matter sequence





Once one ball has been transformed, the child is asked whether there is still the same amount of matter in both balls. The child is continually encouraged to justify his or her answers throughout, in order to determine his or her understanding of conservation.

### **6.5.1 Stage I: Absence of conservation of matter**

The matter non-conserver fails to grasp the conservation of matter, even during transformations which change the appearance of the items only slightly. As with the number non-conserver, the matter non-conserver's perception is egocentric, meaning that the child can hold only one viewpoint in mind at a time and is limited to the present. Thus although the child is able to assert the equality of the matter of the balls in the beginning, he or she cannot bear this in mind when faced with two objects whose perceptual appearance suggests that they contain different amounts. The child also cannot remove him or herself from the present situation to imagine how the balls would appear if transformed back the way they were. The child centres attention on single features of the objects, for example, focusing on the extra length of the sausage without taking into account its corresponding decrease in girth and is convinced that the quantity of matter increases or decreases upon all changes in shape. In addition, there is no logical reasoning behind choosing increases or decreases: it changes from moment to moment.

Piaget stated that non-conservers have no difficulty in justifying their answers because they are fully convinced that the quantity of matter will change whenever the shape is changed. If the sausage is rolled back into a ball, the non-conserver will agree that the

two balls are equal once again. However, if one ball is rolled back into a sausage again, the child will again insist that it holds more clay. This indicates that the child has not acquired reversibility, the ability to follow a series of size transformations and then reverse direction whilst keeping in mind the original form. The child cannot avoid the compelling characteristics of the immediate situation and hold in mind simultaneously what the object looked like before the transformation.

### **6.5.2 Stage II: Intermediate conservation of matter**

Towards the end of the pre-operational stage the child's thinking becomes more flexible. in the same way as in the intermediate stage in number conservation, the child's judgements oscillate between conserving and non-conserving. The child may assert that the sausage and the ball contain different amounts of clay, or may also begin to see that width compensates for length. The child is constantly pulled between different aspects of the stimulus. Piaget terms this decentring: the child is still aware of his or her original impression (i.e. that both balls contained the same amount) but other aspects of the appearance of the clay conflict with this. The child's answers reflect a conflict between direct experience or perception (how the balls appear) and rational operations (what the child *knows* to be true). If the sausage is rolled out long and thin, the child may be swayed by the perceptual appearance of the clay and may say one has more clay than the other. If the sausage is rolled out short and fat, the child may be more inclined to say that it has equal amounts to the ball. When the child relies on perception alone, she will use justifications similar to those used in the previous stage: there is more in the sausage "because it is all spread out" or there is more in the ball because it is "all squashed in".

As soon as the child stops relying on appearance alone, we see evidence that he or she is reflecting on the transformation of the matter. Two particular explanations are invoked, one more commonly than the other. Identification is used most often and is reflected in explanations such as "Nothing has been taken away" and "Nothing has been added". Once the logical operations underpinning identity are understood, reversibility tends to follow. Thus the child answers "If we turn it back into a ball, it will be the same amount". Using reversibility as an explanation indicates operational thinking in that the child is clearly demonstrating that operations can be reversed. However, a single granting that reversal *may* be possible does not denote conservation. In this case it strikes the child as a possibility and not as a logical necessity. If the child thinks it may be possible, this judgement is then based on the perceptual qualities of the physical shapes he or she has seen and is not based on the transformations and the fact that the transformations are reversible. When the child has a true grasp of reversibility she sees that all transformations are reversible and therefore reversibility is a logical necessity.

The main difference between intermediate matter conservation and true conservation is that in the intermediate stage, conservation and operational reversibility are confined to small-scale deformations. This is due to the fact that the operation involved (i.e. reversibility) is not divorced from intuition and is therefore influenced by the perception of the shapes. When the transformation is small-scale (e.g., when a ball is rolled out into a short fat sausage) the child's mind is not compelled by the perceptual appearance of

the objects but when the transformation is larger scale (e.g. when a ball is rolled out into a long thin sausage) perception prevails and conservation is questioned.

### **6.5.3 Stage III: Attainment of the conservation of matter**

The stage of complete conservation of matter is thought to occur at about the age of seven years. In this stage, operational thinking becomes divorced from perceptual appearance and conservation of matter is acknowledged under all circumstances. The child is said to be operating on the basis of logic when he or she can regulate conflicting perceptions and see that all changes in length are consistently compensated for by inverse changes in width.

In the intermediate stage, the child arrives at conservation in simple cases but relies on perceptive intuition for more complex cases. Once complete conservation has been attained it is so automatic that it appears inconceivable to the child that anything else could be possible. Children at the intermediate stage give different responses from one deformation of the ball to the next while conservers have an immediate grasp of the invariance of the matter, with this reflected in their justifications. Conservers recognise that all transformations such as the changing of the ball into sausage can be annulled by the inverse operation (reversibility). This logic is reflected in statements such as "It can be returned to its original shape". Conservers also realise that any arrangement of the same parts results in the same whole (associativity) and that the amount remains the same as long as no material is physically added or taken away (identity). A child who has attained conservation will also be able to invoke compensation as a justification,

which is illustrated by comments such as “It is still the same stuff – nothing has been added and nothing has been taken away”.

**6.5.4 Summary of the stages in conservation attainment**

The above sections emphasise that conservation attainment is a gradual process, characterised by an intermediate stage between non-conservation and conservation. Each stage is characterised by modes of thought, which are similar across different conservation tasks. Table 6.1 summarises the salient features in each of the three stages:

Table 6.1: Summary of stages in conservation attainment

stage	features
non-conservation	thinking limited to present state inability to co-ordinate perceptual changes no conflict between perceptual appearance and counting (egocentrism) perceptual appearance overrules rational operations
intermediate conservation	limited ability to hold in mind previous states inability to co-ordinate perceptual changes conflict between perceptual appearance and rational operations (beginning of de-decentring) judgements oscillate between conservation and non-conservation
conservation	ability to hold in mind previous states ability to co-ordinate perceptual changes rational operations overrule perceptual appearance judgements based on associativity, identity and reversibility

## **6.6 Rationale for using conservation tasks in Study 2**

To return to the criteria that we set out for Study 2, it will now be discussed how collaboration around conservation tasks might fulfil these criteria. Each of the criteria mentioned shall be considered separately.

### **6.6.1 Enhancing the developmental significance of the collaborative task**

As we have seen, progression through various stages in conservation understanding has clear developmental significance. Progress on the tasks depends on the development of rational thinking. It is unlikely that a child will move to a higher level of conservation understanding through practice alone. Equally, it is unlikely that children will underperform due to a lack of motivation. In the kind of construction task used in Study 1, a child who was not motivated was likely simply not to perform as well as he or she was able, with their performance therefore not reflecting their level of ability. In contrast, the level of understanding that a child has attained in conservation will seem self-evident to the child. Normally, once a child has reached a certain level in conceptual thinking, it is then difficult for them to revert to their previous level of thinking. For example, a child who does not understand the concept of floating and sinking may explain such phenomena in terms of weight e.g. a heavy object sinks but a light object does not. However, as the child matures and understands concepts of density, it is difficult for them to understand the basis of their original thought. A child who is not motivated will therefore not provide an answer which is misrepresentative of their level of thinking. In extreme cases, poorly motivated children will simply not answer, or will not provide a justification for their answer, however their conservation judgement will

still be representative of their stage of thinking. A participant will not underperform in the sense of reporting an idea that is below their level of conceptual thinking. Thus if a collaboration experience can be shown to change a child's conceptual thinking, it can be inferred that learning has taken place and that gains made are not simply the result of the child becoming more familiar with the task, or more at ease with the test situation.

#### **6.6.2 Providing opportunities for verbal interaction and the vocalisation of thought processes**

A second advantage of using a conceptually based task for collaboration is that it may encourage discussion. In Study 1 it was noted that many children did not discuss the task and therefore the strategies the children were using were not made explicit. Talk is an important factor in collaboration because children's acquisition of strategies depends on whether they realise that the strategies aid problem solving and some researchers (e.g. Doise & Mugny, 1984) have proposed that discussions during interaction help children to understand the significance of strategies. Discussion is more likely to occur in conservation tasks, as both nonconservers and conservers are equally convinced of the correctness of their own beliefs. While the conserver is aware that their viewpoint is correct, their confidence is not enough in itself for the nonconserver to simply abandon their own incorrect viewpoint, as the perceptual qualities of the objects are simply too seductive and the child's developmental stage is such that no other explanation is possible. The relative states of knowledge of the participants and the high level of confidence that each has in their own beliefs are such that each is more likely to defend



their own beliefs, resulting in discussion and an exploration of the two differing viewpoints.

### **6.6.3 Preventing off-task behaviours**

While the unstructured design of Study 1 was useful in terms of allowing observation of how different groups of children behaved in a naturalistic setting, more structure in the task would have meant that processes known to be useful in terms of learning could have been encouraged. For example, it was difficult for any meaningful discussion of strategies to occur when one partner tended to react to a conflicting viewpoint by ignoring it. In addition, the fact that any one partner had the potential to dominate the interaction may have meant that many children lost confidence and as a result, perhaps did not contribute their own thoughts. Collaboration around conservation tasks allows a more structured format to be used, whereby each child can be given an opportunity to verbalise their own thoughts without being influenced by the more competent child.

Having a structure to the task could of course reduce the spontaneity of the behaviours seen, but in compensation it was hoped that off-task behaviours which did not serve any useful purpose would also be reduced. One of the biggest challenges to Study 1 was devising a task which was appealing to older children and children of a higher ability and encouraged task engagement whilst not appearing daunting to children of a lower ability. Studies involving conservation concepts have been shown to be appropriate for a wide range of age and ability (e.g. Lister et al., 1988; 1989). Part of their appeal is that the questions inherent in them interest children, while making minimal demands on

acquired knowledge or memory (Inhelder, 1968). Conservation tasks thus have a certain attractiveness, whilst always appearing to be within the developmental level of the child. It was expected that these factors would reduce frustration or uncertainty with the task and minimise off-task behaviours.

#### **6.6.4 Reducing variability in partnerships**

Using pairs of children of around the same level of ability was a necessary feature of Study 1 in that it was most representative of what happens when group work occurs in classrooms, with groups typically consisting of children of similar ability. However, it was not clear how the performance of each individual child was affected by the ability of his or her partner. It was therefore not possible to say categorically that children with DS benefited more from collaborative interaction than did the children with NSLD as the lack of improvement seen in the children with NSLD may have been a result of the children with DS being less effective partners.

These factors highlighted a need for a design in the second study that investigated the effect of collaboration on separate groups of children with DS and children with NSLD, whilst controlling for variability in the ability of the partner. Conservation studies lend themselves well in this respect as a clear distinction may be made between conservers and nonconservers. The effects of collaboration on two separate groups of children with DS and NSLD could be investigated, whilst the partners to both groups were conserving children with NSLD. Study 1 indicated that children with NSLD are suitable collaborative partners in terms of helping another child. This allows a clear distinction

between the partner who is a helper and the effect that this has on the child who is being helped, potentially avoiding the confounding effects seen in Study 1 while still allowing the results to be relevant to special school settings. Children with NSLD acted as partners in both groups for reasons of both practicality and relevance: the majority of potential participants with DS were being educated in separate provision and it was felt that the benefits of staying in a familiar setting and working with a familiar partner outweighed the benefits of partnering with a TD child. It is possible that a TD child would have given more sophisticated justifications in terms of language but this benefit may have been outweighed by the possible problems in interaction in terms of social acceptance noted between TD children and children with moderate to severe learning disabilities (e.g. Sinson & Wetherick, 1981, 1982; Sigman & Ruskin, 1999).

## **6.7 Overview**

This chapter has discussed the rationale for using conservation tasks as a basis for Study 2 and has looked in detail at how both conservation of number and matter may be assessed at different stages in their development. The next chapter describes Study 2: an investigation of the effects of collaboration with a partner on the understanding of conservation of number and matter in children with DS and children with NSLD.

## **CHAPTER 7**

# **STUDY 2: PEER COLLABORATION: EFFECTS ON THE UNDERSTANDING OF CONSERVATION IN CHILDREN WITH DOWN SYNDROME AND NON-SPECIFIC LEARNING DISABILITIES**

### **7.1 Introduction**

In chapter 6, a comprehensive rationale was put forward for basing the second collaborative study around conservation tasks. In addition to the points put forward, there are important pragmatic reasons for employing conservation tasks. An understanding of the invariance of number, matter, volume and weight is an essential component in understanding everyday life. Evidence suggests that the range of ability in the development of conservation in children with DS is very broad and that no obvious correlate exists in terms of chronological or mental age, IQ, schooling or sensory impairments (Lister et al., 1989). If collaboration with a peer can be shown to facilitate understanding of conservation concepts this has important educational implications. The attainment of the conservation of number is of particular relevance as number skills are a common weakness in children with DS (e.g. Buckley, 1985; Stith & Fishbein, 1996) and therefore investigation of methods of learning which might promote number understanding are particularly required.

Study 2 aimed to investigate two main questions:

- 1) Can collaborative exchanges with a conserving partner lead to an improvement in conservation of number and matter understanding for children with learning disabilities?
- 2) Are there group differences in outcome between children with DS and children with NSLD following collaboration with a conserving partner?

## **7.2 Method**

### **7.2.1 Design**

A pre-test/intervention/post-test design was implemented. All participants were pre-tested to assess their understanding of conservation of number and conservation of matter. Thereafter, non-conservers of numbers were paired with number conservers on a conservation of number task, while matter non-conservers were paired with matter conservers on a conservation of matter task. The participants who had originally been non-conservers were assessed at a post-test to determine whether the intervention had affected understanding of either conservation of number or matter.

### **7.2.2 Participants**

A total of 47 participants took part: 11 with DS (9 females, 2 males; age range 9 – 16 years) and 36 with NSLD (19 females, 17 males, age range 10 – 16 years). All children attended special schools in the City of Edinburgh or county of Midlothian. None of the participants were from ethnic minority groups. Twenty-four consent letters were initially

forwarded to parents of children with DS in the area and only 1 parent refused permission for their child to participate. The remaining 23 children were all tested but 12 children proved to be unsuitable candidates for this study: 3 had little or no speech or did not reach floor on the British Picture Vocabulary Scale (2 males of 12 years and 1 female of 8 years); 3 evidenced behavioural problems which made testing impossible (2 females of 9 and 12 years and 1 male of 7 years); and 6 were unable to understand the task sufficiently to engage with the pre-test (3 males 7, 11 and 12 years; and 3 females 6, 7, and 7 years).

Consent letters were sent to the parents of 51 children with NSLD. One parent refused permission. Of the 50 children tested, 8 did not meet test criteria in terms of conservation understanding (males age 7 – 11 years) and a further 6 females (age 12 – 13 years) were found to be suitable but were ultimately not required.

### **7.2.3 Matching**

#### *Conservation of number study*

Twenty-one number non-conservers and one intermediate conserver of number (11 with DS, 11 with NSLD) were paired with twenty-two number conservers with NSLD. The DS and NSLD non-conservers/intermediate conservers were matched on their level of conservation of number understanding and chronological age. A measure of receptive vocabulary was also taken using the British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton & Burley, 1997) as receptive language may be a factor in such collaboration studies if participants are to be able to understand the explanations given

by the partner. No attempt was made to match the DS and NSLD nonconservers/intermediate groups on BPVS score however, as expressive verbal ability is known to be low in children with DS and this asynchrony between expressive and receptive language development would have confounded the design. Table 7.1 shows the mean and range of chronological ages and the mean and range of BPVS score for both groups of nonconservers/intermediate conservers and their conserving partners.

Table 7.1: Mean and range of chronological age and BPVS score of participants in the conservation of number study

	n	Mean chronological age (yrs/mths)	Chronological age range (yrs/mths)	Mean BPVS score (yrs/mths)	BPVS score range (yrs/mths)
DS non- conservers/ intermediate	11	13; 6	9; 2 – 16; 6	4; 4	3; 0– 6;4
NSLD non- conservers/ intermediate	11	12; 6	10;7 – 15;10	6; 6	3; 8 – 9;1
Conserving partners of DS group	11	13; 2	10;0 – 16;7	8; 5	6; 9 – 10; 7
Conserving partners of NSLD group	11	12; 6	10;11 – 15;10	8; 6	7; 4 – 9;10

The DS and NSLD non-conserving groups were matched for level of conservation status (10 non-conservers and one intermediate in each group) and chronological age. A paired sample t-test was computed to test whether matching was adequate and indicated no significant differences in chronological age ( $t=0.96$ ;  $df =10$ ;  $p>0.05$ ). The mean BPVS score for the NSLD non-conserving group was significantly higher than for the DS non-



conserving group ( $t = -3.06$ ;  $df=10$ ;  $p<0.05$ ) indicating that the NSLD non-conservers had better receptive language skills than the DS non-conservers.

The partners for both groups of participants were also matched on the basis of conserving status (all were number conservers) and chronological age. Paired sample t-tests were computed to check whether the matching of the two non-conserving/intermediate groups was adequate: there were no significant differences in either age ( $t = 1.23$ ;  $df=10$ ;  $p>0.05$ ) or BPVS scores ( $t = -0.09$ ,  $df = 10$ ,  $p>0.05$ ).

#### *Conservation of matter study*

The same 22 participants (11 with Down syndrome, 11 with NSLD) who took part in the number conservation task were also found to be matter non-conservers. Again, they were paired with 22 matter conservers, all of whom had NSLD. In this part of the study, the DS nonconserving group had the same partners for both the matter and the number study. However, 3 of the participants who had acted as partners to the non-conserving NSLD group were no longer available for the matter study and 3 new partners were recruited. Thus 8 of the 11 partners were the same as those for the number study. Table 7.2 shows the adjusted means and ranges of chronological age and BPVS score for participants in the matter study.

Table 7.2: Mean and range of chronological age and BPVS age equivalent scores of participants in the conservation of matter study

	n	mean chronological age (yrs/mths)	chronological age range (yrs/mths)	mean BPVS age equivalents (yrs/mths)	range of BPVS age equivalents (yrs/mths)
DS non- conservers	11	13; 6	9; 2 – 16;6	4;4	3; 0 – 6; 4
NSLD non- conservers	11	12; 6	10;7 – 15;10	6;6	3; 8 – 9;1
partners to DS number non- conservers	11	13; 2	10; 0 – 16; 7	8;5	6; 9 – 10; 7
partners to NSLD number non- conservers	11	12; 6	10;11 – 16;10	8;3	7; 4 – 9; 7

Paired sample t-tests indicated that there were no significant differences between the group of participants who acted as partners to the DS non-conserving group and the NSLD non-conserving group in terms of either chronological age ( $t = 0.11$ ,  $df = 10$ ;  $p > 0.05$ ) or BPVS scores ( $t = -0.22$ ;  $df = 10$ ;  $p > 0.05$ ).

#### 7.2.4 Procedure

##### *Number*

The conservation of number task was similar to that used by Piaget (1952). As the average mental age of children in the study could be assumed to be relatively low, it seemed at first, more appropriate to use the McGarrigle and Donaldson (1974) ‘Naughty teddy’ version of the task. It is believed that this version allows children to conserve number at ages younger than Piaget had suggested. However, pilot testing on this task with children with NSLD indicated that it was not particularly helpful. In fact, the

addition of the naughty teddy seemed to be a distracting factor and appeared to add more confusion to the test situation.

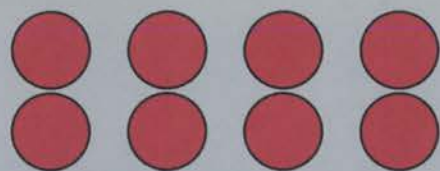
The reasons for this were unclear. One possible reason is that while young pre-school children are willing to believe that a teddy is an animate object that is capable of independent acts, older children (even those with learning disabilities) may have a more advanced conception of animism and are less likely to attribute a sense of agency to the teddy. Older children are aware that the adult's actions and the 'teddy's' actions are one and the same. As a distinction between the adult's and the teddy's actions is necessary for the child to disassociate the adult's question and his or her actions this particular paradigm may not have the same effect with older children as with younger children. This highlights one of the many problems inherent in testing children with a relatively low mental age who nevertheless have the benefit of considerable years of experience of everyday events.

In addition, it is known that many children with learning disabilities (and not just children with autism) have problems with attainment of a theory of mind (e.g. Binnie & Williams, 2002; Yirmiya et al., 1996; Zelazo et al., 1996). The participants may have become confused by the need to take on the viewpoint that the teddy was naughty and might do unpredictable things that were not expected by the examiner. If the children perhaps could not take the viewpoint of the naughty teddy (that he wants to mess up the

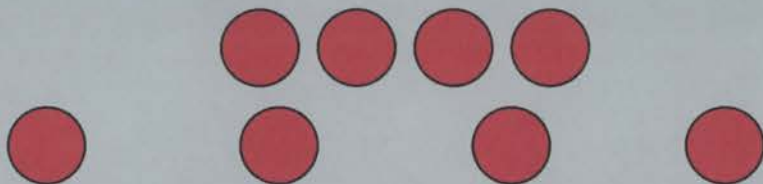
display) the transformation of the display would not necessarily be seen as an 'accident', but simply the examiner changing the display, albeit with a stuffed toy in her hand. Smarties were substituted for the buttons used in the standard form of the test in order to maintain the child's interest. Each problem began by presenting two rows of four Smarties spread out in one-to-one correspondence (see figure 7.1).

The child was asked to judge whether the rows were equal in terms of number. One row of Smarties was subsequently transformed in full view of the child by pushing apart the Smarties in order to make the row appear longer. The child was asked to compare the original row with the transformed row with regard to number. The examiner used the set phrase "Are there the same number of Smarties in both rows or does one row have more Smarties than the other?" Once the child had made a judgement, the researcher attempted to elicit an explanation for the child's judgement. This was attempted in a way that would not signal to the child whether their answer was correct or not. The researcher used the set phrases "How do you know that?" and "Can you tell me why that is?" The original interview techniques employed by Piaget were informal and unstructured. In this study however, two groups were being compared and therefore a level of comparability had to be built into the design. For this reason, the examiner used a standard format for questioning. This was also in order to avoid the possibility that the researcher might inadvertently become a source of cognitive conflict through her questioning, either encouraging the child to reflect back on her previous judgements or by pointing out any inconsistencies in the child's thinking.

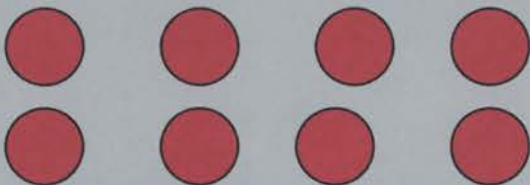
Figure 7.1: Procedure for conservation of number task



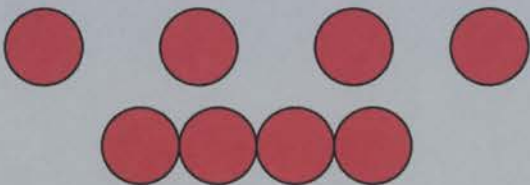
"Is there the same number of Smarties in both rows, or does one row have more Smarties than the other?"



"Is there the same number of Smarties in both rows, or does one row have more Smarties than the other?"



"Is there the same number of Smarties in both rows, or does one row have more Smarties than the other?"



"Is there the same number of Smarties in both rows, or does one row have more Smarties than the other?"

Once the first transformation had taken place, the rows of Smarties were pushed back into two rows of equal length in one-to-one correspondence and the child was once again asked to state whether he or she thought there were equal numbers of Smarties in both rows. Immediately following this, one row was once again transformed, this time by pushing together the Smarties in that row to make one row appear shorter and denser. The same form of questioning took place as following the first transformation.

All conservation judgements and explanations of those judgements were recorded using a Walkman tape recorder and were later transcribed. The judgements made in the pre-test were the basis for assigning the participant to a category of either non-conserver, intermediate conserver or conserver. The scoring system is explained in more detail under the 'scoring' section (see 7.2.5 below).

The collaborative intervention session took place 7-10 days after the initial assessment. In this session DS and NSLD number non-conservers were paired with NSLD children who had been scored as number conservers in the pre-test. The session followed the same procedure as the pre-test session. After each transformation the non-conserver was first asked to make a judgement and give a reason for it before the conserver was asked. This was to prevent the nonconserver from simply agreeing with the conserver's judgement and thereby not expressing her own opinion. In some cases, once the conserver had stated his or her opinion, a spontaneous discussion ensued. Where this was not the case, the researcher pointed out that the children had stated differing

viewpoints and asked them to attempt to come to a consensus. In some cases, a discussion would ensue, in others the non-conserver would simply concede that the conserver was correct without attempting to defend their own viewpoint. Once again, the intervention session was audio recorded and later transcribed. The post-test session was a repeat of the procedure used in the pre-test without the presence of a partner, and took place 14-16 days after the collaborative intervention. Again, dialogue in the post-test was recorded and transcribed in order to ascertain a post-test level of conservation understanding.

### *Matter*

The technique for investigating conservation of matter in Study 2 was again an adaptation of the classic version of the Piagetian test (Piaget & Inhelder, 1974). In the original study, the child was asked to judge two equal balls of clay for equality of matter. One ball is transformed and compared several times and the child is asked again to judge equality of matter, weight and volume. The child is expected to compare his or her predictions or explanations with the results of weighing the balls on a scale and by submerging them in water to gauge the amount of water that is displaced. In the present study, the task was simplified to assess understanding of conservation of matter only. On the basis of the literature it was felt that few participants in the age range to be tested would have been likely to reach understanding of volume or weight and that it could be confusing to the child to be asked about more than one aspect of conservation in a single session. In addition, testing predictions or pointing out discrepancies is a way of



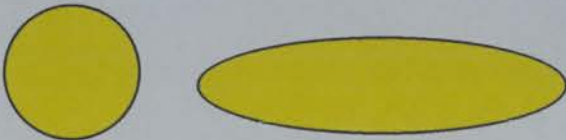
introducing cognitive conflict and it was important to avoid this in the pre-test. This is especially true when an adult is involved as the child may defer to the adult's obvious experience and ability and could perhaps be influenced to take on the view of the adult. As the main purpose of Study 2 was to determine whether a peer partner could make a difference to conceptual thinking, comparing the child's beliefs to reality in this way could have confounded the results.

In the present study Playdough was used instead of clay. The child was presented with two equal balls of Playdough and asked to make a judgement on the equality of the balls in terms of matter (see figure 7.2)

Figure 7.2 Procedure for the conservation of matter task



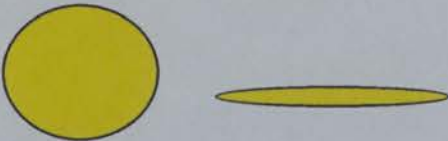
"Is there the same amount of Playdough in both balls or does one have more Playdough than the other?"



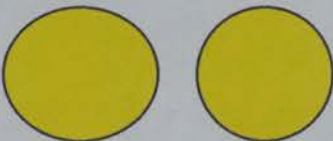
"Is there the same amount of Playdough in the sausage as there is in the ball, or does one have more Playdough than the other?"



"Is there the same amount of Playdough in the pile of pieces as there is in the ball, or does one have more Playdough than the other?"



"Is there the same amount of Playdough in the pancake as there is in the ball, or does one have more Playdough than the other?"



"Is there the same amount of Playdough in both balls or does one have more Playdough than the other?"

Being able to understand and confirm equality of the balls was a necessary prerequisite for participation in the task and six children who were unable to do so could not take part in the study. During the matter task, the children manipulated the Playdough themselves, in order to maintain their interest. Firstly, the child was invited to transform one of the balls into a sausage shape, thereby making it appear longer and thinner, while leaving the remaining ball in its original form. The researcher attempted to ensure, in as far as was possible, that each child rolled a sausage of similar dimensions. For example, if a participant rolled a very short, fat sausage, the researcher would advise the child to “keep rolling a little longer”. Once the child had made the sausage shape, the researcher then asked the child to comment on the equality of the two shapes by asking: “Is there the same amount of Playdough in the sausage as there is in the ball, or does one have more Playdough than the other?” Once again, after the child had made a conservation judgement, the researcher encouraged the child to elaborate on his or her thinking by asking “Why’s that?” or “How do you know that?” Again, no indication was given as to whether the response was correct or incorrect. The researcher then asked the participant to break up the sausage shape into a pile of pieces and the child was again invited to comment on the equality in terms of matter by asking “Is there the same amount of Playdough in the pile of pieces as there is in the ball, or does one have more Playdough than the other? Following this transformation, the child was instructed to turn the pile of pieces into a pancake and was asked “Is there the same amount of Playdough in the pancake as there is in the ball, or does one have more Playdough than the other?” In all cases the child was encouraged to verbalise a justification for his or her judgement.

Finally, the child was requested to return the pancake to a ball and was asked to comment on the equality of both balls. All responses were recorded and later transcribed to form the basis for scoring the child's pre-test level of conservation of matter understanding.

As in the conservation of number study, the collaborative intervention session took place 7-10 days after the pre-test. The sequence of transformations was repeated in the collaborative session along with requests for conservation judgements and justifications for those judgements. As was the case in the number study, matter non-conservers were asked for their judgements and justifications before the conserver was asked in order to prevent contamination of spontaneous responses. Again, the researcher attempted to encourage discussion of differing viewpoints after each transformation. The post-test was a repeat of the procedure for the pre-test and took place 14-16 days after the intervention session.

#### **7.2.5 Scoring criteria**

On both the conservation of number and matter tasks, transforming the objects several times allowed more opportunity to determine the child's understanding of conservation given the rigid question format. For example, in the case of intermediate conservers, the answer given may appear to be the answer of a non-conserver on one transformation, yet they may appear to be the answers of a conserver on another transformation. Such children may conserve in some situations but in situations where the objects are very dissimilar, they can be swayed by perception. For example, a child may be able to

conserve when one ball is transformed into a short fat sausage, but when it is rolled into a very long thin sausage they are persuaded by the object's appearance that the amount has indeed changed. Several transformations also allow for any conflict to become apparent when the child becomes aware that he or she has made contradictory judgements. The criteria used for assigning the participant to either the nonconserving, intermediate or conserving level were based on the discussion of attainment of conservation in Chapter 6. The scoring systems detailed in tables 7.3 and 7.4 were used:

Table 7.3: Scoring criteria for conservation of number task

status	features
non-conservation of number	<i>judgement:</i> non-conservation of every transformation <i>justification:</i> based on perceptual appearance <i>example:</i> "That row has got more because it's bigger"
intermediate conservation of number	<i>judgement:</i> oscillates between non-conservation and conservation <i>justification:</i> based on perceptual appearance sometimes, other times based on numerical equivalence <i>example:</i> "They are still the same number, but that one's longer so it must have more."
conservation of number	<i>judgement:</i> conservation on every transformation <i>justifications:</i> based on compensation, identity and reversibility <i>examples:</i> " It just looks more because it's all spreaded [sic] out." "They were the same number to begin with and you didn't add any or take any away so they are still the same number" "It's the same - you can just push that row back together again."

Table 7.4: Scoring criteria for conservation of matter task

status	features
non-conservation of matter	<i>judgement:</i> non-conservation of every transformation <i>justification:</i> based on perceptual appearance <i>examples:</i> “The sausage is longer, so it must have more Playdough” “The ball’s got more – it’s higher”
intermediate conservation of matter	<i>judgement:</i> oscillates between non-conservation and conservation <i>justification:</i> based on perceptual appearance sometimes, based on equivalence of matter <i>examples:</i> “The pile has more because it’s all spread out...well it’s the same Playdough, but that one’s got more”
conservation of matter	<i>judgement:</i> conservation on every transformation <i>justifications:</i> based on compensation, identity and reversibility <i>examples:</i> “It’s the same – the pancake is all spread out, but it’s thinner too” “You didn’t add any Playdough so it’s the same.” “You can just turn the sausage back into a ball.”

### 7.3 Results

Study 2 aimed to investigate whether children with DS and NSLD could benefit from collaboration in terms of their understanding of conservation and secondly, whether any group differences in learning outcomes might be seen. Tables 7.5 and 7.6 show the original pre-test classifications and post-test classifications for both tasks for the DS and NSLD participants. Table 7.5 indicates that 6 out of 11 of participants with DS showed improvements in understanding of conservation of number and 5 of the 11 showed improvements in understanding of conservation of matter following collaboration.

**Table 7.5      Conservation status of DS group at pre- and post-test**

	number		matter	
participant	pre-test	post-test	pre-test	matter
1	NC	NC	NC	NC
2	NC	NC	NC	NC
3	NC	NC	NC	NC
4	NC	NC	NC	NC
5	NC	NC	NC	NC
6	NC	I	NC	NC
7	NC	I	NC	I
8	NC	I	NC	I
9	NC	C	NC	I
10	NC	C	NC	I
11	I	C	NC	C

Table 7.6 shows the data from the NSLD participants. In this group only 2 of the 11 participants showed improvement in understanding of conservation of number and 2 showed improvement in understanding of conservation of matter following collaboration.

**Table 7.6: Conservation status of NSLD group at Pre- and Post-test**

	number		matter	
participant	pre-test	post-test	pre-test	post-test
1	NC	NC	NC	NC
2	NC	NC	NC	NC
3	NC	NC	NC	NC
4	NC	NC	NC	NC
5	NC	NC	NC	NC
6	NC	NC	NC	NC
7	NC	NC	NC	NC
8	NC	NC	NC	NC
9	I	I	NC	NC
10	NC	I	NC	I
11	NC	C	NC	C



The fact that there were more improvements across both groups on the conservation of number than matter task is not surprising, given that most participants were originally non-conservers of both number and matter at pre-test and conservation of matter understanding requires a higher level of conceptual understanding.

Pre- to post test changes in both the DS and NSLD groups for the conservation of number and matter tasks are represented graphically by figures 7.3 – 7.10.

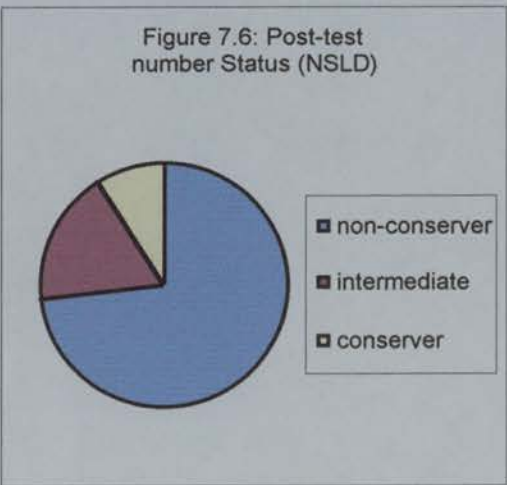
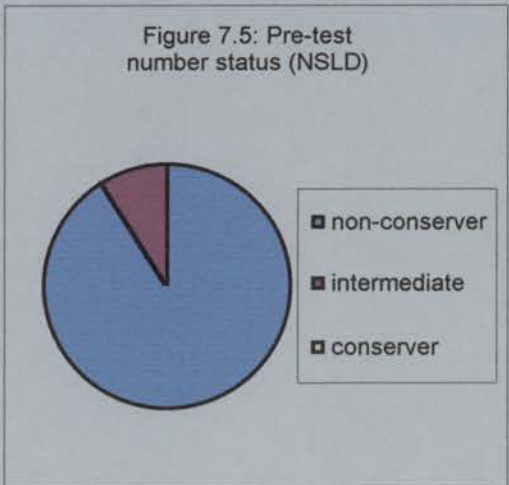
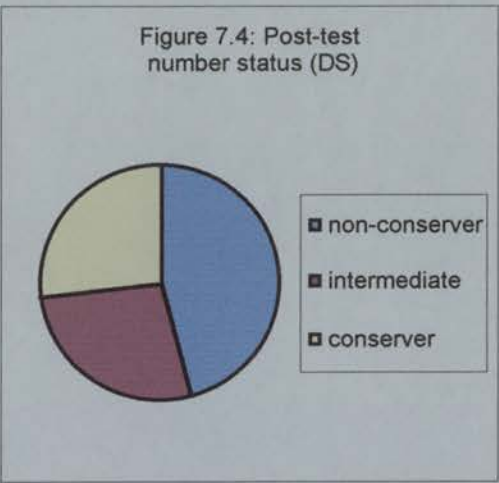
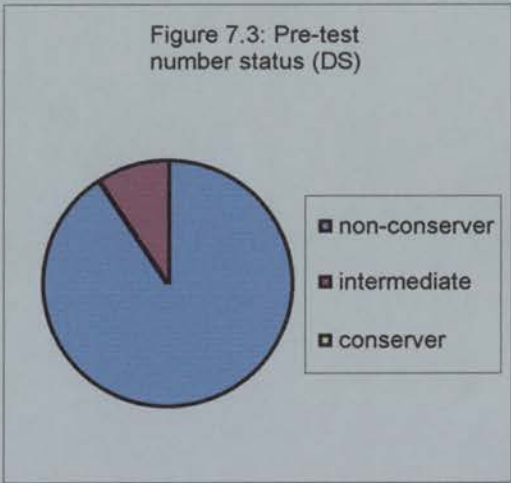


Figure 7.7: Pre-test  
matter status (DS)

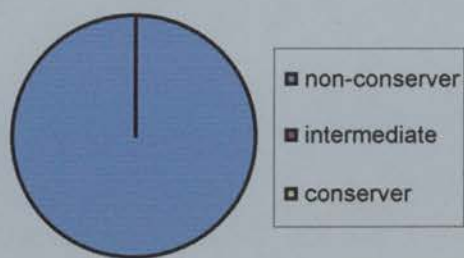


Figure 7.8: Post-test  
matter status (DS)

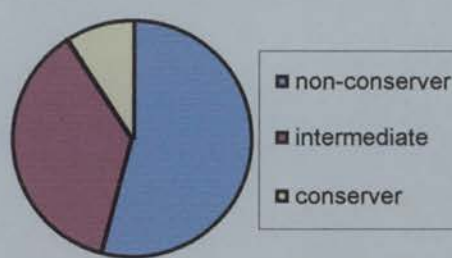


Figure 7.9: Pre-test  
matter status (NSLD)

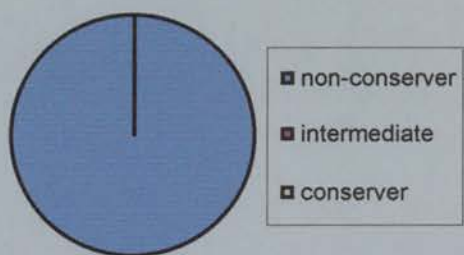
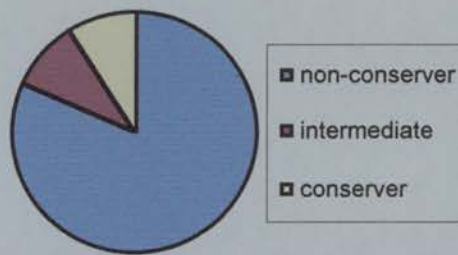


Figure 7.10: Post-test  
matter status (NSLD)



To test whether there were group differences in performance after collaboration, the groups of children with DS and NSLD were divided into children who improved after collaboration and those who did not. Chi-square tests showed no association between group and status in terms of improvement or no improvement in either the number (Chi-square = 3.14,  $df = 1$ ,  $p > 0.05$ ) or the matter task (Chi-square = 3.14,  $df = 1$ ,  $p > 0.05$ ).

While no group differences were apparent when the data were viewed simply in terms of improvement or no improvement, the magnitude of change is obviously of relevance also, with an improvement from non-conserving to conserving obviously being more impressive than a change from non-conserving to intermediate conservation. In the conservation of number task 3 participants moved from non-conserving to full conserving status following collaboration (2 with DS, 1 with NSLD). Similarly, two non-conservers of matter were able to fully conserve following collaboration (1 with DS, 1 with NSLD). However, from tables 7.5 and 7.6 it is apparent that some participants moved from a non-conserving to an intermediate conserving status and that some progressed from being intermediate conservers to full conserving status.

## **7.4 Discussion**

### **7.4.1 The efficacy of the socio-cognitive conflict model for children with Down syndrome**

The results from Study 2 demonstrate that children with DS may benefit from peer collaboration on conservation of number tasks. This finding is particularly interesting, given that Study 2 was based around a task placing heavy emphasis on socio-cognitive conflict. This is a theoretical framework which has not regularly featured in studies of collaboration in children with learning disabilities in the past, although it has been shown to be effective for TD children. The results of this study also suggest that children with DS may benefit from working in collaboration with other children with learning disabilities given the appropriate setting and that collaboration need not be limited to

partnering children with learning disabilities to TD children in a classic tutoring or teaching paradigm.

In this study, the proposed mechanism for driving cognitive growth is socio-cognitive conflict. The findings from this study suggest that encouraging children with DS to face inconsistencies in their thinking via a social situation may cause cognitive re-structuring in the same way. The majority of participants in the study improved their conservation status by one level only, that is they either improved from a non-conserving status to an intermediate status or from an intermediate status to a conserving status. Fewer children improved by two levels, that is, from a non-conserving to a conserving status, the commonly accepted criteria for success in the TD literature. This is not surprising however, given the slow rate of development generally found in children with learning disabilities and the fact that the test session was a one-off experience of collaborative learning. Obviously, an improvement from a non-conserving to a conserving status is a rather more impressive improvement and this has been claimed to have been seen in TD children after only one session (Perret-Clermont, 1980). A change from being a non-conserver to an intermediate conserver is nevertheless no small achievement as this also involves a conceptual change, even although this information has not been fully consolidated. In addition, given that some children with learning disabilities may never achieve understanding of conservation over a lifetime, its potential significance should not be dismissed.

While the changes in conservation understanding seen are encouraging, the question may be asked whether these changes do truly reflect a genuine cognitive restructuring or whether they may come about through some simpler mechanism. It could perhaps be argued that these improvements in conservation understanding might have been a result of the less able child simply modelling in the post-test the explanation given by the conserving child in the collaborative session. Obviously, it would be possible for the child to simply reiterate the justifications given by the conserver without having internalised any of the accompanying thought processes. This explanation might be thought to be particularly relevant to the children with DS in this study as Wright (1998) has shown that imitation is a low-level strategy that is commonly used by children with DS in situations where TD children attempt to consolidate information.

One way of negating this hypothesis is to look in the post-test data for novel justifications of the conservation judgements made (i.e. explanations which were not provided by the conserving child and therefore could not have been copied). If the child who was previously a nonconserver is able to make a conservation judgement and justify that judgement with a novel explanation, it can be assumed that the change in conservation understanding has arisen through a process of the child assimilating and ordering information in logical fashion, leading ultimately to real cognitive growth (Perret-Clermont, 1980). In order to test this hypothesis, the post-test justifications used by the children who had improved in conservation status were examined and compared with the justifications used by that child's partner in the collaborative session. In the

conservation of number task, it was found that 3 out of the 5 children with DS and one out of the two children with NSLD had used an original justification which was not used by the more competent partner in the collaborative session. In the conservation of matter task, four of the five children with DS and both the children with NSLD who had improved their understanding used an original justification for their conservation judgement. From this, it can be assumed that the majority of improvements in conservation understanding could not be accounted for by simple modelling. Note that this does not imply that the improvements seen in the children who did not use entirely original justifications in the post-test are due to modelling. There are a limited number of justifications that can be used to explain a conservation judgement and in some cases the partner employed several justifications in one session, leaving less opportunity for the participants to employ a completely novel justification.

It could be argued that the results would have been strengthened by the inclusion of a second post-test to ascertain whether the improvements seen were enduring.

Unfortunately, this was not possible due to a combination of school timetabling and imminent school holidays. While it would have been especially convincing had the results endured until a second post-test, mixed findings might have been less easy to interpret. Children with learning disabilities may show unstable performance (Inhelder, 1968) and children with DS in particular have difficulty in maintaining gains (e.g. Wishart, 1988, 1993a). What this study has at least demonstrated is that forms of collaboration that attempt to influence the metacognitive processes and thus promote



logical thinking could well be useful for children with learning disabilities in the same way that they have been shown to be for TD children. The stability of the gains made as a direct result of such interventions cannot, however, be commented on at this stage.

#### **7.4.2 Dialogue**

While the findings of improvements in levels of understanding of conservation are of most interest in this study, some note should be taken of the dialogue produced in the collaborative sessions in the two groups. In particular, it was noted that many of the non-conserving children had enormous difficulty in verbalising a justification. This is not altogether unusual, as Inhelder noted:

“A methodological difficulty is noted. Retarded subjects do not volunteer their opinions. Perhaps this is not due to their faulty mental functioning, but without doubt it constitutes a trait characteristic of their mentality, which can result from an inferior level of development.”

(Inhelder, 1968: p.89)

This reluctance to explicate one's thinking might stem from the children's difficulties with cognition in general, but it is not as easy to see how this argument might follow in the case of conservers who are able to logically order different representations but who still had great difficulty justifying their judgements. It may be a phenomenon related more to the environment and the typical learning histories of children with learning disabilities, in that children with learning disabilities are not accustomed to being asked



to explain their reasoning and their history of learning failure may have taught them to say nothing rather than risk being wrong.

Despite the fact that this difficulty in producing explanations was apparent in many of the participants, articulating an explanation seemed to be somewhat more of a problem for the children with DS than for the children with NSLD. While children with NSLD would often give inadequate responses, such as “It just is” or “I just think so”, children with DS were more likely to refuse to answer by saying, “I don’t know” repeatedly, shrugging their shoulders or simply looking away. In the conservation of number task, 7 out of the 11 participants with DS refused to justify their response on at least one occasion, while only 3 out of the 11 participants with NSLD did so. Similarly, in the matter task 3 participants with DS refused to justify a conservation judgement at least once, while only 1 of the NSLD participants refused. It is perhaps worth noting that none of those who refused to give justifications later went on to improve on understanding of conservation.

Again, this finding reflects findings from Study 1 – that children with DS may verbalise their thoughts in learning contexts less than children with NSLD. This may be a result of the difficulties that children with DS have with articulation and with making themselves understood, leading in some cases to a reluctance to verbalise ideas. A reluctance to verbalise one’s own ideas may have far-reaching implications for cognitive development. Verbalising ideas allows one to come into discussion with others and

consequently reflect on one's own thinking. It is only when ideas are brought out into the public domain that they can be examined for inconsistencies. While it is easy to think inconsistent or illogical thoughts, once verbalised, they are noted by others and inadequate or illogical patterns may well be pointed out.

Researcher notes also revealed that the participants with DS were more likely than the NSLD participants to attempt to provide a non-verbal explanation in this study. Instead of articulating explanations for their conservation judgements some children would attempt to demonstrate their beliefs through actions rather than words. For example, when asked if a sausage and a ball had the same amount of Playdough in them, one girl with DS provided a conserving response and when asked to justify that judgement, said "Look!", rolled the sausage back into a ball, then held up both balls saying "See – the same". Such actions seem to indicate that the child has grasped the principle of reversibility. However, as the child could not explicate this verbally, she could not be classified as a conserver. These non-verbal explanations are interesting in that they are not a feature of the pre-test sessions: they appeared only in the post-test sessions. In the post-test for the number task, they appeared 5 times in the group of participants with DS and once in the group of participants with NSLD; in the matter task they were used 6 times in the group of participants with DS and once in the group of participants with NSLD. It is also notable that they were used in place of explanations in the group of children with DS, while in the group of children with NSLD they tended to be used to supplement verbal explanations. Thus although we might have assumed that the

participants with DS did not provide explanations because they were disinclined, the appearance of the non-verbal explanations suggests more that they have great difficulty in verbalising their train of thought. Richardson (1998) argues that children may have an implicit grasp of certain covariations yet may be unable to express this understanding in the form of speech on the basis that this requires a new and different attention to the variables and their interrelations. In adults this may be analogous to learning a foreign language. While one may be able to read in a foreign language and understand the meaning, being asked to translate it may mean having to re-read it before beginning. Richardson quotes Vygotsky (1962, p.149):

“... there is no rigid correspondence between the units of thought and speech...Thought has its own structure, and the transition from it to speech is no easy matter.”

Thus while an operatory structure may be in place, the child may have difficulties in reflecting on this abstractly. This seems to be a particular problem for children with DS. An inability to volunteer opinions might contribute to learning difficulties in that it may hinder consolidation of learning. It is possibly a defence mechanism adopted by children with a life-long history of learning failure, who may have learned that you cannot be wrong if an opinion is never ventured. Equally, it may be an epiphenomenon of teaching methods commonly employed in special education. Common methods are individualised tasks, rote learning, errorless learning and breaking tasks into decontextualized parts.

Less emphasis is placed on metacognitive strategies although research into this area has shown that children with learning disabilities may benefit from such an approach (Powell & Makin, 1994; Sullivan et al., 1995; Watson, 1996).

Individualised tasks do not allow the child to come into contact with other children with differing opinions and present them with the opportunity of defending their own opinion. Errorless learning also prevents the child from being faced with inconsistencies in his or her own thinking and from having to resolve those inconsistencies.

## **7.5 Overview**

From Study 2, it is again apparent that collaboration with peers may be an effective method of improving conservation understanding in children with DS. This is the case even when the collaborative partner has learning disabilities. This is a notable result, given that previous research into collaborative learning in children with learning disabilities has mainly been modelled on a tutoring basis, often with the 'tutor' being a TD child. Collaborative methods of learning may be particularly suitable for children with DS as they are thought to find it difficult to consolidate information. Thus although they may have an implicit rudimentary understanding of a concept, it may be difficult for them to explicate this information in a logical form and ultimately consolidate it into a coherent 'unit' to be committed to memory. Collaboration may be an effective way of promoting consolidation in children with DS, in that verbal explication of ideas and discussion, even if not extensive, facilitates logical ordering of thought.

## **CHAPTER 8**

### **STUDY 3: A COMPARISON OF THE EFFECTS OF DIRECT TEACHING AND CONTINGENT ASSISTANCE ON THE PROBLEM-SOLVING SKILLS OF CHILDREN WITH DOWN SYNDROME**

#### **8.1 Introduction**

Studies 1 and 2 have indicated that collaborative problem solving can be beneficial to the child with DS. Study 1 was based on a peer collaboration design with equal ability pairs while Study 2 was a peer collaboration design with an 'expert' and a less competent peer. Both studies were similar, however, in the fact that neither relied upon direct teaching as a method of promoting positive outcomes. Instead, it was likely that the gains shown resulted from participants in these studies being able to use the knowledge of their partners as a basis for improving their own knowledge and for reflecting back on their own strategies. In addition, in both studies participants were expected to direct their own learning without adult guidance. Study 2, in particular, indicated that cognitive conflict as a result of hearing opposing opinions could be an impetus for cognitive change for children with DS. In sum, both studies indicated that children with DS could be active learners who are able to act upon external information to their benefit.

Children with DS are known to be reluctant to practice existing skills, or engage in challenges just ahead of their current level. There is also a popular view that children with DS are very engaged during social interactions (e.g. Ruskin, et al., 1994b). Collaborative learning may therefore operate by offering the child with DS an intrinsically interesting forum in which to consolidate information.

One reason why children with DS fail to consolidate information effectively is their tendency to use low-level problem-solving strategies. Wright (1998) showed that children with DS are adept at using strategies such as imitation to complete tasks for which TD children would use more cognitively-based strategies. Thus it may be that a direct teaching paradigm is less beneficial to children with DS in the longer term as it allows them to continue using low-level strategies. Study 2 indicated that where collaboration might be of particular benefit is in provoking children with DS into reflecting on their own strategies and thereby challenging their thinking.

Paradoxically, the teaching methods that are promoted for children with learning disabilities are commonly based on direct teaching methods, derived from behaviourist techniques. For example, Westwood suggests that 'explicit teaching' is an appropriate method of teaching for children with learning disabilities and describes it as a method which gives children "very clear instructions, demonstrations, explanations, practice and corrective feedback for each new step in learning" (Westwood, 1997, p.6). Similarly, Landry et al., (1994) also noted that children with DS were more co-operative, and

showed more initiative when provided with a structured task accompanied by direction, while control children responded better to suggestive strategies. In addition, teaching methods used with children with learning disabilities tend to make low levels of intellectual demand (e.g. Bennett, 1991; Watson, 1996) and little attention is paid to metacognition and strategies for learning (e.g. Male, 1995; Riding & Read, 1996; Swanson, 1984).

Scruggs and Mastropieri (1993) note that for children with difficulties in learning, direct teaching methods based on behavioural techniques may indeed prove to be the most effective method for teaching skills, in which logical connections are difficult to make such as spelling and vocabulary acquisition. Such methods may be successful on these tasks precisely because they make few intellectual demands. However, Scruggs and Mastropieri also note that these direct teaching methods target content acquisition, while more constructivist methods of instruction target the thinking processes of the pupils.

Paradoxically, methods of instruction based around metacognition, and where the responsibility for the task lies with the child may be particularly useful to children with DS. As they have problems with consolidation and mastery motivation such methods may be more likely to provoke a change in strategy or concept than other methods.

Study 3 aimed to investigate whether children with DS can benefit from a more constructivist collaborative teaching strategy which relies on encouraging the child to



reflect on his or her own strategies for the task. Constructivist methods also allow the child to direct the pace of learning and to take more responsibility for the task, as the assistance given is contingent upon the child's current understanding of the task. The effect of a contingent assistance paradigm was therefore compared to a more directive teaching strategy and a practice control condition. A more contingent approach has similarities with studies involving cognitive conflict as the mechanism involved focuses on making the child aware of his or her thinking while provoking new patterns of thinking. With contingent instruction, the partner never simply demonstrates the solution; instead the responsibility for solving the task lies with the child. The partner gauges when to hand over responsibility and when to increase the explicitness of the instruction. In this way, it is not apparent that the more competent person has a solution which he or she then attempts to impart to the less expert person through a kind of transmission model. Instead, it is assumed that the child will be able to 'discover' the correct solution him or herself, given the appropriate hints. In Study 3, the partner was an adult (the researcher). This design was decided upon for logistical reasons, mainly on the grounds that even TD children do not usually have the skills to provide truly contingent help (e.g. Martinez, 1987). However, it should be noted that the aim of Study 3 was not to compare the effect of different partners (adult vs. peer) on the collaborative interactions of children with DS. Rather, it was to determine which particular mechanisms associated with collaboration are particularly useful for the child with DS. The next section will now explain in more detail the basis of contingent assistance and

will consider the similarities and differences between contingent assistance and studies invoking the mechanism of socio-cognitive conflict.

## **8.2 The essence of contingent assistance or 'scaffolding'**

Contingent assistance, or 'scaffolding' as it is often called (Wood, Bruner & Ross, 1976), is a form of instruction that has been traditionally associated with adult-child interactions. However, it is by no means a unidirectional model of transmission of knowledge from a more skilled to a less skilled person. Rogoff and colleagues (Rogoff, 1990; Rogoff et al., 1993) use the term 'guided participation' to emphasise the joint participation of the learner. They describe how the interpersonal transaction in this model involves the adult offering support and challenging the child's thinking, gradually increasing the child's ability to function at an independent level, all the while building upon the child's natural predisposition to learn and understand. A major linking to the idea of socio-cognitive conflict as a precursor to cognitive change is the assumption that all children are driven to construct their own knowledge.

From this viewpoint, contingent assistance has much in common with theories which promote socio-cognitive conflict as a precursor to cognitive re-structuring within the child. There are similarities in the following ways. Firstly, any instruction is dependent upon the child's prior knowledge. With contingent assistance, the adult calibrates his or her assistance according to the child's current level of understanding, while in studies of socio-cognitive conflict, the children use each other's current beliefs as a basis for

discussion of the task. In other words, they operate upon each other's thinking.

Secondly, the aim of both types of instruction is to provoke new cognitive structures. In the case of successful scaffolding, the child can begin to appreciate a new procedure or strategy to accomplish a goal, while the presence of socio-cognitive conflict is thought to encourage the child to reflect on an area of knowledge in a different way.

The essence of successful scaffolding involves promoting better understanding of what is involved in successful completion of a task, rather than simply promoting a better outcome for that particular task, such as could occur through direct teaching methods or even simple copying (Wood, Bruner & Ross, 1976). Although the notion of contingent assistance or scaffolding has often been used rather imprecisely, there are some studies which have attempted to investigate in greater depth the processes involved in scaffolding (e.g. Saxe, Gearhart & Guberman, 1984; Wertsch, Minick & Arns 1984; Wood, Bruner & Ross, 1976; Wood & Middleton, 1975). Stone (1998) noted that during the 1980s a commonly accepted set of characteristics of scaffolding became evident. Firstly, it was based around titration of assistance provided by the adult during the interaction. The mechanism behind this was:

‘an online’ diagnosis of the child’s understanding and/or skill level, together with careful calibration of the support provided to help him or her accomplish the goal or subgoal.’”

(Stone, 1998: p.349).

Secondly, different types of support could be provided to help the child, including non-verbal assistance or extensive dialogue. Thirdly, a crucial point was that support had to be gradually withdrawn as the child progressed in order to transfer responsibility for the task from the adult to the child.

Pacifici and Bearison (1991) compared the performance of three-year-old children who had received different types of adult assistance during a puzzle-completion task. One group received naturalistic assistance from their mothers, while another group received adult assistance as a function of the child's moment-to-moment success at inserting puzzle pieces. Assistance was calibrated according to a hierarchy of increasingly explicit prompts. Although both groups made significant improvements, the children who had received calibrated assistance improved more. Similarly, Day and Cordon (1993) compared the effectiveness of scaffolded and non-scaffolded instruction for eight- to ten-year-olds on a balance-scale task. Again, in one condition assistance was calibrated to the child's immediately preceding behaviour. Day and Cordon also measured for impulsivity, achievement orientation and verbal intelligence and found that even after the effect of these characteristics had been partialled out, scaffolding produced significantly better outcomes. In other words, while these characteristics could predict learning success in the non-scaffolded children, scaffolded instruction compensated for the effects of these characteristics.

### **8.3 Rationale for Study 3**

While the traditional image of the parent or teacher 'teaching' the child has relied on a unidirectional transmission model in which the child is seen as a relatively passive receiver of information, the scaffolding image encompasses a complex social interchange, fostering a conceptual reorganisation and ultimately new understanding. Stone (1998) notes that this type of assistance has been deemed suitable for higher ability children, but apparently unsuitable for less able children. While there is some evidence to suggest that contingent assistance or scaffolding can be a superior form of teaching and learning for students with milder learning difficulties (e.g. Bos & Anders, 1990; Englert et al., 1991, 1994; Graves & Montague, 1991; Woodward & Baxter, 1997) little work has been carried out with students with more substantial learning disabilities. In addition, the population of children with learning disabilities is a heterogeneous one and without research on specific groupings, generalisations cannot be made. Children with different aetiologies for their learning disabilities may have specific problems which might make contingent instruction difficult. Some authors have in fact suggested that children with DS are a particularly difficult group to scaffold (e.g. Meadows, 1996).

Study 3 set out to determine the relative efficacy of different models of collaboration for children with DS. It was based around constructing three-dimensional models of two-dimensional spatial designs. On this particular task, a deeper level of understanding could be reached by inferring transferable strategies for the designs that could either be simplified or elaborated for different models. The main aim of the study was to compare

a simple practice effect (repeating a task and becoming familiar with it) with a direct teaching effect (demonstrating the correct solution) and a contingent or 'scaffolded' condition (the whole solution is rarely modelled, instead the 'expert' gives hints based on the current performance level of the child and adjusts this instruction as necessary).

In the contingent learning condition, instruction was finely tuned to the child's current level of performance. If the child failed to respond to a general verbal prompt, more explicit prompts could be given or the examiner could model small parts of the model. The emphasis was on guiding the child into using a more efficient strategy through calibrated help, rather than simply modelling a solution.

The direct teaching condition was based on the "swing strategy", which is a type of non-scaffolded instruction used by some of the mothers in Woods and colleagues' (1978) study of mothers teaching their child to construct a pyramid. In this strategy, if the child failed to respond to a general verbal prompt from the mother (such as "See how much you can make"), the mother modelled the solution to that stage in the problem, only to return to another general verbal prompt at the next stage. Thus the mother's assistance swings between general verbal prompts and demonstrations of the relevant stage in the task. The swing strategy is a useful comparison to contingent assistance as it controls for help from an interactive adult but is not contingent upon the child's level of understanding.

Within the literature, scaffolding is usually associated with an adult partner. However, the intention of Study 3 was not to compare the effects of different partners for children with DS: rather this study accepts that there may be common strands within aspects of peer collaboration, peer tutoring and scaffolding. The reason for utilising an adult partner in this study is mainly to remove the ability of different partners as a source of variation. The strand that may be common to all of these types of learning is the possibility of promoting learning at a deeper level. While it may have been a component of the peer collaboration design seen in Study 1, other, perhaps easier, methods of learning were also available, e.g. practice or copy effects. Nevertheless, there was some indication that a few children were able to reflect on their own thinking and compare their own efforts to the target model which in turn may have allow reflexive thinking or a shift in strategy to take place. The second study was structured so that the influence of socio-cognitive conflict might be more salient, that is participants were encouraged to verbalise the thinking underlying their decisions and thus encouraged to reflect on their own thinking. This may in some ways be analogous to contingent learning, in that no attempt is made to directly teach, rather the child is encouraged through verbal assistance and demonstrations from the partner to construct a solution to the problem for him or herself.

The main difference between studies based around socio-cognitive conflict and scaffolding is that scaffolding is much more contingent. In classic socio-cognitive conflict studies, the child is simply presented with an opposing viewpoint and is left to



make the connections by him or herself. In scaffolded tasks, the hints that provoke the child's thinking are contingent upon the level the child is at and are tailored to the current needs of that child. In this way, the adult guides the child towards making logical connections. Thus the purpose of Study 3 is not to consider the effects of different partners; it is to consider how children with DS might react to different methods for learning which may be described as a practice method, direct teaching or contingent assistance that is finely calibrated to the child's current level of ability and understanding.

#### **8.4 Generalisability of learning**

Wood, Wood and Middleton (1978) proposed that scaffolding comprised a process, through which children could recognise and internalise more advanced solutions. One way of checking whether a more advanced solution has been internalised is to check for generalisability. If a child is able to transfer strategies learnt during one task to a similar task, in the absence of cues associated with the original task, it can be assumed that a generalisable strategy has been learnt. Again, we can think of learning a new strategy as a process that is similar to what happens during Piaget's explication of cognitive conflict. Old cognitive structures are challenged by hints and prompts from the partner, until the child begins to break down the old structures and patterns of thinking and replace them with superior structures. In Study 3 the design was extended to allow participants to be given a second post-test on a conceptually-similar task for which no intervention had taken place. This was to test the extent to which any learning could be

generalised, or in other words, whether the intervention had provoked a cognitive change in terms of learning a new strategy or whether the participants had learned only how to accomplish that particular task better.

## **8.5 Method**

### **8.5.1 Materials**

Study 3 was based around the Triangles subtest of the Kaufman Assessment Battery for Children (K-ABC: Kaufman & Kaufman, 1983; age range 3-18 years) and the Pattern Construction sub-test of the British Ability Scales II (BAS-II: Elliot, 1996; age range 2-18 years). Both are non-verbal scaled measurements based on block design items. In such tests, a child typically copies a two-dimensional pattern by arranging three-dimensional blocks. Thus the child is required to analyse and synthesis the sample design. The scores achieved on such tests are thought to reflect spatial problem-solving, including components such as visuo-spatial analysis, and the use of particular strategies such as sequential processing, or trial and error. The Triangles subtest on the K-ABC is thought to be a prototypical measure of simultaneous information processing (Kaufman & Kaufman, 1983). Simultaneous information processing refers to the mental ability of the child to integrate input simultaneously to solve a problem correctly. In order to solve items on both tests, one must be able to mentally integrate the components of the design to see the whole or more accurately perhaps, break down the design into its constituent parts.

Furthermore, Triangles and Pattern Construction sub-tests were chosen for the basis of this study because:

- the two tests are similar enough to reasonably expect success on one task to generalise to the other;
- they are graded according to difficulty, beginning with easier patterns and increasing in complexity, allowing their use with children of differing ability levels;
- they both contain teaching items, thereby lessening the chances that participants will fail early items due to an inability to understand instructions.

A short description of each test can be found in appendix H.

### **8.5.2 Participants**

Consent to participate in the study was requested from parents of 46 children with DS who were currently being educated in special provision schools within the City of Edinburgh or the Lothians area at the time of the study. Parental permission was declined for three children. 43 children with DS aged between 7 and 18 years were pre-tested. Of these, 4 children (3 males of 7, 7 and 10 years, and one female of 9 years) were excluded due to an inability to comprehend the task or to behavioural difficulties which made testing impossible. In total 39 children with DS (23 females and 16 males) aged between 9 and 18 years participated in the study.

As stated earlier, the Triangles test from the K-ABC and the Pattern Construction test from the BAS-II were the basis for comparing performance. The Triangles test awards one point per correct item in the test, with a maximum score of 18. On the Pattern Construction test children of higher ability attempt more sets of items than lower ability children. Because children take different sets of items their raw scores cannot be directly compared. Therefore, the raw score is converted to an ability score which reflects both the raw score and the difficulty of the items being administered. The lowest possible ability score was 10, while the highest possible score was 194. The participants in all three conditions were matched in order to allow for an equal range of abilities in each group. As the intervention was based around the Kaufman Triangles from the K-ABC, the original intention was to match on the Triangles subtest. However, all participants were pre-tested on both the Kaufman Triangles and the Pattern Construction sub-test from the BAS-II and it became apparent that the Pattern Construction sub-test was a finer measuring instrument in terms of the lower ability groups. The Kaufman Triangles failed to discriminate between slight differences in ability in the lower range. For this reason, participants were matched on the Pattern Construction subtest. Table 7.1 shows the mean and ranges for chronological age (CA) and pre-test ability based on the Pattern Construction sub-test. A one-way analysis of variance was computed to check for group difference in score and age. No significant differences were found, confirming that the three groups had been adequately matched for both pre-test score on the Pattern construction sub-test ( $F(2,36) = 0.027$ ;  $p > 0.05$ ) and chronological age ( $F(2,36) = 0.83$ ;  $p > 0.05$ ).

Table 8.1: Mean and range of chronological age and pre-test score for Pattern Construction sub-test

learning condition	n	mean CA (yrs & mths)	range CA (yrs & mths)	mean Pattern Construction ability score	range Pattern Construction ability score
control	13	14;2	9;0 – 18;8	63	21 - 98
direct teaching	13	13;0	9;2 – 17;9	62	21 - 97
contingent assistance	13	13;5	9;4 – 15;8	61	21 - 95

### 8.5.3 Design and Procedure

Study 3 used a pre-test, intervention, post-test design.

#### *Session 1 (pre-test)*

Participants were pre-tested on both the Kaufman Triangles and the BAS-II Pattern Construction sub-test. Both sub-tests were administered in a standard manner, with the exception that the children started at a lower item than their chronological age (the first item on both tests for all participants). All items were timed. On the basis of Pattern Construction sub-test scores, participants were assigned to one of three groups, with an equal range of ability in each group.

The three groups formed 3 conditions: a control condition, a contingent learning condition and a direct teaching condition based on the ‘swing strategy’ (Wood, et al. 1978). From a study of mother-infant interaction, Wood et al. (1978) identified five levels of task control on which all maternal interventions could be classified. These are the basis for differentiating between the direct teaching and contingent assistance conditions and are described overleaf.

### Wood's levels of intervention:

- Level 1: *General verbal encouragement*  
The instructor urges the child to action with a general request e.g. "Good, do something else now" or "See what you can make."
- Level 2: *Specific verbal information*  
The instructor tells the child what to look for, or how to assemble parts, by mentioning size or other relevant attributes.
- Level 3: *Selection*  
The instructor becomes physically involved by selecting or indicating appropriate pieces.
- Level 4: *Prepared material*  
The instructor places the blocks in such a way that the child need only push them together.
- Level 5: *Demonstration*  
The instructor demonstrates one operation or step in the construction.

### *Control condition*

In the control condition, the Pattern Construction task was simply repeated without being timed with the instructor permitted to give level 1 (i.e. general non-verbal encouragement) instruction where necessary.

### *Direct teaching condition*

In the swing strategy, the instructor followed the swing strategy of teaching described by Wood et al. (1978). The instructor began with a complete and explicit demonstration of how to solve the first problem then asked the child to attempt it. If the child failed, the full solution was given again before moving on to the next problem. If the child was able to solve the second problem, the instructor provided level 1 prompts before presenting

the child with the next problem. If the child failed to complete the item, a full solution was then given on the next problem. Thus, children in this condition received a complete solution if they were unable to solve the task, regardless of their performance up to that point. The adult partner effectively 'swings' between level 1 and level 5 for the duration of the task.

### *Contingent assistance condition*

In the contingent assistance condition, the level of instruction given was calibrated according to the child's performance. Wood et al. suggested that a simple rule be followed: "If the child succeeds, when next intervening offer less help. If the child fails, when next intervening take over more control". Thus the instructor attempts to progressively hand over control to the child, while leaving him or her with a limited scope for error.

### *Session 2 (intervention/control)*

Session 2 followed 7-10 days after the pre-testing sessions. All intervention/control sessions were based on the Kaufman Triangles. In the intervention/control sessions, items were not timed, as adhering to time limits would have interfered with the contingency of response in the contingent assistance condition.

In the control condition the same procedure was followed as for the pre-test, with the exception that participants could spend as long as they required on each item. No



assistance was offered although non-specific verbal encouragement was permitted as in the pre-test. Participants started with the first item in the test and completed each item until they reached the discontinue rule given in the K-ABC manual (child fails every item in one unit). Although starting with the first item made the test session longer, it gave the child ample opportunity to practise on easier items before graduating to more difficult items.

In the direct teaching condition, the adult partner and the child sat side-by-side in order that the examiner could demonstrate the model the correct way round. In order to do so, two sets of Triangles materials were required. The adult partner instructed the child that they would repeat the task that they had done in the pre-test, only that she would help when the child became 'stuck'. The adult partner began the interaction with a complete and explicit demonstration of the first problem then asked the child to attempt the problem. The child was given general prompts when necessary. If he or she failed to respond correctly or produced an incorrect model, the adult partner demonstrated the correct solution, after which the child received another general prompt on or next step in the problem. Children in this condition received a complete demonstration if an incorrect solution was produced, regardless of their level of performance up to that point. Again, the session was discontinued at the point at which all the items in one set had been failed.

In the contingent assistance condition, one set of Triangles only was used. The examiner attempted to calibrate the assistance offered to the child's performance as much as possible. No prompts were offered as long as the child appeared to be reproducing a correct solution. As soon as the child ran into difficulties, the examiner offered explicit prompts tailored to the child's current difficulties based on Wood's levels of intervention. If the child still failed to reproduce a correct solution or did not respond to the prompt, the examiner was able to offer more explicit prompts or model a partial solution. Prompts and demonstrations were based around a general goal of explicating common strategies for such a task, such as breaking the picture into small segments, hiding pieces of the picture with hands to make smaller segments more salient, and making smaller sub-components then fitting them together to make a whole. Thus both verbal and non-verbal instruction was used. Again, all participants in this condition began with the first item in the test and continued until the child was unable even with help to reproduce all the items in a set.

### *Session 3 (post-test session)*

The post-test session followed the intervention/control session by 10 – 14 days. In this session all participants were administered both the Kaufman Triangles and the Pattern Construction subtests in a standard fashion again, with the exception of starting with the first item in the test rather than the age-appropriate item. All responses were timed and no assistance was given on any condition with the exception of non-specific verbal encouragement. The aim of session 3 was threefold:

- 1) to determine whether any improvement was seen in independent performance on the Triangles subtest;
- 2) to determine whether any improvement seen was related to condition;
- 3) to determine whether any improvement seen was generalised to performance on the Pattern Construction test

## 8.6 Results

### 8.6.1 Levels achievable with help (pre-test/intervention score comparisons)

One way of examining data of this type is to consider the difference in the level achieved by the child without assistance (i.e. the pre-test score) and the level they are able to achieve with the assistance of another (the level reached during the intervention).

In Vygotskian terms, the former would be considered to be a measure of *actual* development, while the latter is considered to be a measure of *proximal* development.

Table 8.2 shows the difference in score between the pre-test score which the child achieved alone and the score achieved in the intervention with the help of the adult for the two contrasting conditions. The highest possible score was 18. From this table, we can see that in the contingent assistance condition all participants achieved a higher score than they had achieved alone. The mean increase in score for this condition was 11 points. In the direct teaching condition, the majority of the participants did perform at a higher level than they had in the pre-test. However, four participants did not show an increase in level with the assistance of an adult. The mean change in score for the direct teaching group was only 4 points. Thus while direct teaching appeared to benefit some

children, the results were less consistent over the group as a whole, and the average amount of improvement was less than in the contingent assistance group. This was confirmed by a Mann-Whitney test ( $z = 3.21$ ;  $p < 0.01$ ). To return to Vygotskian theory, this result confirms that contingent assistance taps proximal potential in children with DS more efficiently than does a direct teaching method, on this particular type of task.

Table 8.2: Difference between pre-test and intervention session Triangles score for intervention conditions

participant	contingent assistance	direct teaching
1	17	16
2	15	10
3	14	6
4	13	6
5	12	5
6	12	4
7	10	3
8	9	2
9	9	2
10	8	no change
11	8	no change
12	7	no change
13	4	-1

### 8.6.2 Effects on learning of contingent assistance versus direct teaching

Whilst contingent assistance appears to tap potential ability more effectively than direct teaching, the question remains whether it is more effective in terms of learning outcome. In order to determine this, measures of the child’s ability to perform the task alone must be considered also. In the present study, comparisons of final pre- and post test scores on the Triangles subtest were the basis for determining whether the performance of

participants had improved. A one-way analysis of variance confirmed that there were no differences in pre-test scores  $F(2,36) = 0.56; p > 0.05$ . Table 8.3 shows the mean and standard deviation of the pre-and post-test scores for the Triangles subtest. This table indicates that the biggest mean change in score was in the contingent assistance condition.

Table 8.3 Mean and SD of Triangles pre- and post-test scores per condition

condition	pre-test		post-test	
	mean	SD	mean	SD
contingent assistance	1.8	1.7	7.2	4.3
direct teaching	3.0	3.8	3.9	4.4
control	2.9	3.4	2.8	3.2

A 1-way analysis of variance was computed on the pre-to post-test difference in score for each condition and confirmed that group differences existed ( $F(2,36) = 15.17; p < 0.01$ ). Post hoc Scheffé tests indicated that the differences lay between the contingent learning and the control condition and between the contingent learning condition and the direct teaching condition. Thus the contingent teaching condition is the only group to improve significantly. The changes seen in the direct teaching condition are not significantly different to the control condition. In addition, the results seen in the group who were assigned to the contingent assistance condition were significantly better than those seen in the direct teaching condition.

Figure 8.1 shows a boxplot of the pre- to post-test change in scores for the Triangles subtests. From this, it is apparent that the contingent assistance condition is the only one where the median difference score is significantly above zero. In the control condition, the 25<sup>th</sup> and 75<sup>th</sup> percentiles are equivalent to the median, indicating that most scores were clustered near to the zero mark, with two extreme values in the positive direction and two extreme values in the negative direction. Thus, while most scores did not improve, a few did and some regressed. In the direct teaching condition, the median is slightly above zero but the box indicates that the majority of the scores were between zero and the median. The ‘whiskers’ indicate that the lowest change in score was below zero. In essence then, the contingent learning group was the only condition under which the majority of participants showed significant improvements (one score remained the same).

Figure 8.1: Boxplots of pre- to post-test differences in Triangles score per condition

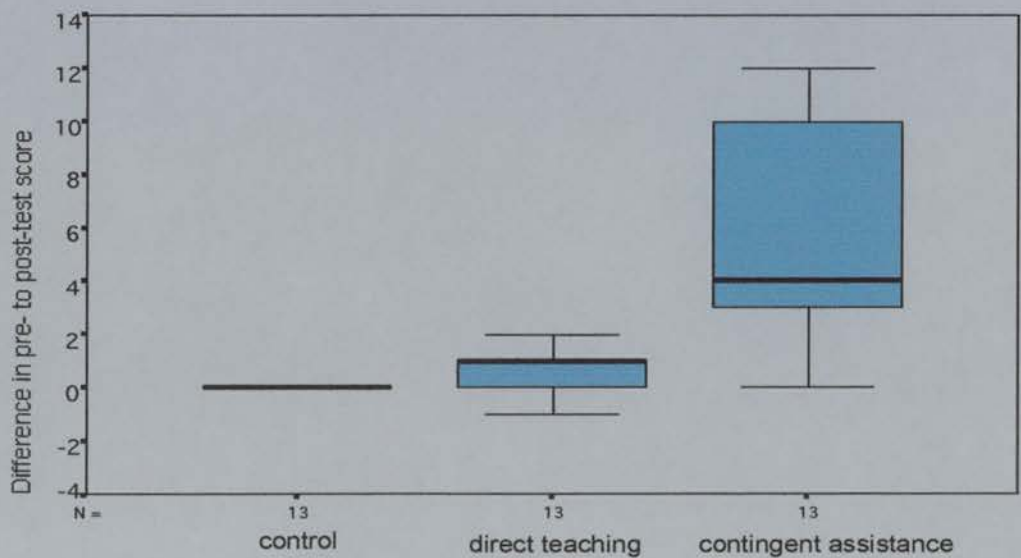




Table 8.4 shows the total number of participants who regressed, stayed the same or improved for the Triangles subtest. From this we can see that regressions are most common in the control conditions. In cases where participants retained the same score over three sessions, this was often a result of using a very low-level strategy which was inappropriate for the task. For example, some participants repeatedly used a strategy that had been successful on a previous item for the next few items even although it produced incorrect solutions. In other cases, participants would only fully engage with the items up until items that they had passed easily. When faced with more challenging items, they would simply produce a solution that they obviously knew to be incorrect (e.g. placing materials in a haphazard fashion), possibly as a non-negotiable way of disengaging with the task.

Table 8.4 No. of pre- to post test advances, regressions and no-change scores on Triangles sub-test

Condition	n	advance	regression	no change
contingent assistance	13	12	0	1
direct teaching	13	8	3	2
control	13	2	3	8

**8.6.3 Generalisability of new learning**

Comparison of pre- and post-test scores on the Pattern Construction subtest was the basis for determining whether learning within the Triangles intervention could be generalised to a similar task for which no teaching had taken place. Table 8.5 shows the mean and standard deviation of pre- and post-test scores for the Pattern construction subtest for each group. Again, it is apparent that the biggest change in mean score is in



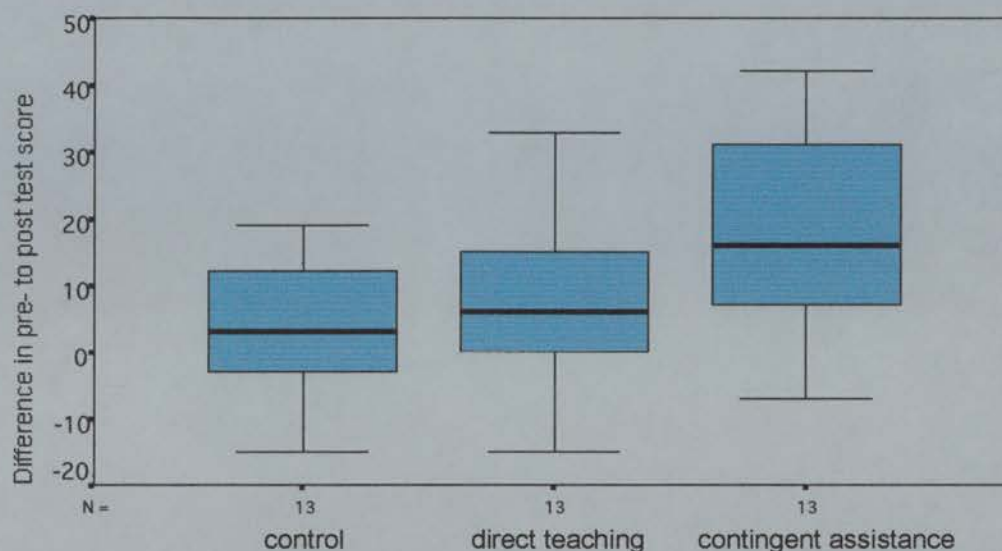
the contingent assistance condition. It is worth reiterating that pre-test scores were not significantly different.

Table 8.5 Mean and SD of pre- and post-test scores on Pattern Construction sub-test

condition	pre-test		post-test	
	mean	SD	mean	SD
contingent assistance	61	23	77	20
direct teaching	62	22	68	23
control	63	23	65	23

Figure 8.2 shows boxplots of the pre-post test change in score for the Pattern Construction test. As with the Triangles test, it is apparent that for the control and direct teaching conditions, the change in median is not much higher than zero. The median score for the contingent assistance is the only one that is much higher than zero, with the majority of scores in a positive direction.

Figure 8.2: Boxplots of pre- to post-test differences in Pattern Construction scores per condition



A 1-way analysis of variance of the differences in score between the pre- and post-test scores confirms that significant group differences existed  $F(2,36) = 3.5$ ;  $p < 0.05$ ) and a post hoc Scheffé test indicated that the difference lay between the control group and the contingent assistance group only. The direct teaching group was not significantly different to the control group, suggesting that improvements seen in this group were no more than would be expected from a practice effect.

Table 8.6 shows the total number of advances, regressions and no-change scores on the Pattern Construction test. Unlike the Triangles test, regressions were seen in every condition although once again, most regressions were found in the control group. This is

likely to be due to the fact that some participants in the control group simply attempted to evade engaging with the task, as they had done on the Triangles task.

Table 8.6 Pre- to post test advances, regressions and no-change scores on Pattern Construction sub-test

condition	n	advance	regression	no change
contingent assistance	13	11	2	0
direct teaching	13	9	3	1
control	13	7	4	2

## 8.7 Discussion

### 8.7.1 Effects of intervention

Study 3 set out to compare the effects of different collaborative teaching paradigms on the performance of children with DS on two spatial tasks. The effects of contingent assistance and direct teaching were compared to a control condition whereby simple practice effects were measured. Contingent teaching paradigms have not been traditionally employed with children with DS as there seems to be an implicit assumption that such teaching methods are suitable only for relatively high ability children (Stone, 1998). Overall, it could be said that when collaborative processes have been investigated in children with DS, the emphasis has been on more didactic methods in which a more able person attempts to impart knowledge to a less able person. The main difference between such a model and contingent assistance lies in the locus of responsibility. In traditional tutoring models, the responsibility for teaching the task rests with the more able person; in contingent assistance models, the child and the partner assume joint responsibility for the task. In addition, responsibility is transferred as soon

as the child shows that they are capable of a particular component. The lack of research into contingent assistance and studies involving socio-cognitive conflict seems to imply that children with DS are not likely to be able to assume responsibility for their own learning and will not be motivated to make connections that have not been made explicit. In the direct teaching condition, the adult assumes all responsibility for the task, in that they attempt to provide a full and explicit solution to the problem as soon as the child indicates difficulties.

The results from Study 3 clearly indicate that contingent assistance is a more effective mode of teaching and learning for children with DS than direct teaching on this type of task. Contingent instruction has already been shown to be superior to other forms of teaching for the TD child (e.g. Wood, Wood & Middleton, 1978) but it is often assumed that forms of teaching that are appropriate to the TD child are not always appropriate to children with learning disabilities such as DS. Indeed, some studies have indicated that children with DS may benefit from a more directive instruction. The results from this study refute this notion. Children with DS, as do TD children, may benefit more from a learning situation in which the instructor allows the child to take responsibility for those components which the child is able to manage.

The potential benefits of contingent assistance are apparent both in terms of pre- to post-test outcome and in the ability to generalise new learning to a similar task. The mechanism underpinning the success of the contingent assistance condition becomes

more transparent when the difference between what the child could achieve alone and with assistance is considered. In the contingent assistance condition, all participants were able to achieve a higher score with the help of the adult partner than they had achieved alone and the difference in score overall was relatively large. We may relate this relatively large difference in score to the Vygotskian notion of the zone of proximal development. Working within a child's zone of proximal development involves working within a specific area between what the child is able to achieve alone (actual development) and the upper limit that they are able to reach with assistance (proximal development). In order to achieve this, the instruction must always remain at a level just slightly above the child's actual capabilities. Once the child shows him or herself to be capable of a procedure, assistance is withdrawn. The help offered in the contingent assistance condition produced consistent and impressive results.

This contrasts somewhat with the results seen in the direct teaching condition. In this condition, the effects were less consistent in that 4 of the 13 participants were not able to achieve a higher score with the adult partner than they had achieved alone. In addition, the differences in score between pre-test and intervention scores were not as impressive as those seen in the contingent assistance condition. In this particular condition, assistance was not contingent, that is participants who had difficulties with the task were shown a complete solution, regardless of how much of the task they had been able to complete alone. Such instruction could not be said to operate within the child's zone of proximal development and consequently did not address the child's potential ability.

Instead, it operated only on the basis that the child was not able to complete the task, without taking into account the aspects of that particular item that the child was able to complete unaided.

### **8.7.2 Generalisability of learning**

Children with DS have often been reported as having problems with consolidation of learning (Morss, 1983). It is thought that this lack of consolidation may lead to the fluctuations in test scores commonly seen in children with DS (e.g. Dunst, 1981; Morss, 1983; Wishart & Duffy, 1990). In the present study, the generalisability of learning was assessed by the extent to which participants were able to transfer skills they had learnt in the intervention to another similar task for which no intervention had taken place. Only the participants who had taken part in the contingent assistance condition showed any significant change in pre- to post test score on the generalisability task. From this, we may assume that participants in the contingent assistance condition had learnt not only problem-solving skills in relation to a specific task, but also had learnt a more efficient strategy which they were then able to transfer to another task. The ability to transfer a strategy from one task to another implies that this learning has been adequately consolidated. Had the learning not been consolidated, it would be extremely difficult to be able to reproduce solutions in another situation lacking the relevant cues. Clearly, if some of the characteristic cognitive problems seen in children with DS relate to poor consolidation skills, contingent assistance paradigms may be an effective way of circumventing such problems.

One of the ways in which contingent assistance may promote consolidation of skills is by preventing the child with DS from employing low-level strategies to complete tasks. It was noted that the contingent assistance intervention condition was the only condition where no regressions in score took place, that is participants scoring less on the post-test than they had originally done on the pre-test. It was noted that in those cases where this had occurred, participants were using a very low-level strategy to complete items. Similarly, in cases where participants retained the same score across all 3 sessions, it was usually due to the inappropriate use of a strategy that had worked on previous items. In some of the items on a test, a particular strategy would work for two or three items in a row. When an item was then introduced which required a slightly more complex strategy, some participants would simply persevere with the previous strategy, even when it was apparent that it could not produce a correct solution. This is consistent with other research which has suggested that children with DS often resort to low-level cognitive strategies (Wright, 1998; Wishart, 1996; Morss, 1983).

In cases of regression, where the post-test score was actually less than the pre-test score had been, it was noted that many participants were effecting an evasion strategy. Often, they would complete one or two easy items then resort to placing the blocks or triangles in an obviously haphazard manner for the duration of the trial. If the adult partner questioned this, the child would invariably smile but insist they had completed the task to their ability. In this fashion, participants were able to avoid engaging with the task without actually refusing to take part. This is remarkably similar to a report by Wishart



(1996) of participants with DS simply choosing the same cup over and over on repeated trials of object concept tasks.

An important point to make here is that while these characteristic features were found in all three groups for both tasks at the pre-test, they were not apparent in the contingent learning group during the intervention sessions and became less apparent at the post-test. A decrease in the use of low-level strategies was also noted in the post-test session for the Pattern Construction test. From this we might suggest that contingent learning helped to promote more effective strategies in the children with DS and consequently meant that they relied less on counter-productive problem-solving approaches.

## **8.8 Overview**

It appears then that one of the causes of a poor problem-solving approach in children with DS may lie in the difficulties that they experience in consolidation. When faced with a choice, children with DS appear to prefer to avoid a task, rather than engage with a challenging cognitive problem. If this is the case, collaboration with a partner may be the ideal forum to circumvent a poor learning style in children with DS. Children who are poorly motivated, may be influenced by more outer-directed rewards such as the approval or praise of another person. Indeed, it has been reported that children with DS become particularly focused in the presence of another (e.g. Vietze et al, 1983).

Contingent assistance seems to be a particularly effective method for teaching problem-solving skills for two main reasons: firstly, it captures and maintains the attention of the

child with DS through providing constant and contingent feedback, secondly, it simultaneously promotes the use of more effective learning strategies. In order to engage with, and receive the positive endorsement of the person present the child must address increasingly complex strategies for completing the task. Such a method of learning would seem to increase the chances of consolidating effective strategies.

## **CHAPTER 9**

### **CONCLUSIONS**

#### **9.1 Introduction**

This thesis set out to explore collaborative problem solving in children with DS, an area that has not previously been considered in the field of Down syndrome research. The aim was to explore how collaborative interaction affects children with DS, both in terms of the efficiency of their problem-solving skills and their overall approach towards learning. A secondary aim was to explore how the results of this thesis relate to the existing literature on collaborative learning and through this, to locate cognition in children with DS within wider developmental theory.

Three inter-linked studies investigated various aspects of the themes mentioned above. The aim of this chapter is not to reiterate the discussion sections of each study; rather it is to pull together the wider ramifications of the combined results and to assess the contribution they might make to the existing literature.

The most salient question to be addressed by this thesis is whether collaboration with another person can positively affect the problem-solving skills of children with DS. It is generally accepted that collaboration is an effective forum for learning in TD children but there has been little investigation of collaborative processes with regard to cognitive development in children with learning disabilities. This thesis has indicated that

collaborative interchanges may be useful to children with DS as a means of advancing specific problem-solving skills. This may work at two levels. Firstly, it may work at the cognitive level by encouraging children with DS to reflect on and consolidate existing knowledge. Secondly, it may work at a more affective level, serving to intercept counterproductive approaches to problem solving and providing a supportive framework within which the child can learn. Both of these possible interpretations shall be considered in more detail below.

## **9.2 The effect of collaborative learning on cognitive processing in children with Down syndrome**

As stated above, a main aim of this thesis was to examine whether collaborative problem solving could have a positive effect on the problem solving skills of children with DS in terms of learning outcomes. The three studies comprising this thesis suggest that collaborative problem solving can indeed have a positive effect on learning outcomes in children with DS. The results from each study will be further unpacked in order to illustrate this point.

Study 1 was the least structured design, allowing participants to work alongside each other without interference from the adult observer. In many cases in this study, there appeared to be little in the way of collaboration in the sense of both children working on the same part of the model. In fact, when the tapes were reviewed it appeared that for the majority of the time, some dyads were engaged in what could be best described as

parallel engagement, that is both children appeared to be engrossed in their own activity, without paying much heed to the partner. When the videotapes of the collaborative session were analysed in finer detail, however, a different picture emerged. In some dyads, while one partner would work, the other sat passively observing the partner. It might appear that children who did so could not benefit much from the potential opportunities afforded by collaboration. However, there appeared to be no direct link between the amount of time spent on- or off-task and post-collaborative outcomes, and perhaps an explanation for this is that while some children did not appear to be actively engaged in a physical sense, they were nevertheless engaged in a cognitive sense. In the DS and the TD group in particular, there is evidence that cognitive processing was taking place. These groups used more instances of speech indicative of cognitive conflict. The utterances in this category indicated that the child had compared an external model (either the partner's or the target model) to an internal model (the child's perceived version of the model, or the child's belief of how the model should be constructed) and found discrepancies between the two. This is equivalent to Piaget's disequilibrium stage, where the child becomes aware of a conflict between his or her own beliefs and contradictory information. Piaget proposed that being in disequilibrium is an uncomfortable cognitive state which will drive the child to reconcile the available information and thereby cause new cognitive structures to form. From Study 1 then we might conclude that while it is not always apparent that children are actively collaborating, they may nevertheless be actively processing information coming from the partner at some cognitive level.

In Studies 2 and 3 there is even stronger evidence to suggest that collaboration can have a positive effect on the cognitive processes used in problem solving. In Study 2 the performance of non-conserving children with DS and NSLD were compared after collaborative interaction with a conserver. The results from this study indicated that improvements in the understanding of conservation could be achieved through exposing non-conserving children to the reasoning of conserving children. Study 2 was based around conservation of number and matter tasks in which it is unlikely that practice or exposure to the task would effect an improvement in understanding.

On the basis of these findings, it was therefore proposed that the driving force for improvement in conservation understanding was cognitive conflict, which arose as a result of being exposed to the contradictory viewpoint of the conserving child. As opposing views are reconciled, new cognitive structures may form. Further weight is added to this argument by the fact that many of the previously non-conserving children were able to use novel justifications for their conservation judgements. The production of a novel explanation, which had not been previously used by the conserver during the collaborative interaction, indicates that the non-conservers could not have simply modelled their judgements on those of the conserving child. Instead it suggests that new cognitive structures had formed, as a result of the previously non-conserving child processing the 'new' information which had become available in the collaborative session.

Study 3 used a spatial copying task to compare the effects of a collaborative contingent learning condition to a direct teaching condition and a control condition. In the collaborative contingent learning condition, unidirectional positive changes were seen. Participants in the other two conditions did not show significant gains. There was again evidence to suggest that children with DS who participated in the contingent learning condition formed new cognitive structures as a result of collaboration. Firstly, it was noted that participants in this condition were able to use more sophisticated strategies in the post-test than they had in the pre-test, while there was little evidence of strategy change in either of the other two conditions. Secondly, children who had participated in the contingent learning condition were shown to have improved significantly on a similar task where no intervention had taken place, suggesting that learning on the original task was generalisable. This ability to transfer strategies for one task to another similar task is an extremely important component in cognitive growth as it suggests that the child has learnt a superior strategy.

In summary, the three studies that comprise this thesis provide evidence that collaborative problem solving is a potentially effective method for learning in children with DS. There is also evidence to suggest that the improvements in learning seen are not just the result of behavioural or linguistic modelling, but are the result of a re-ordering of information at the cognitive level.



### **9.3 The effect of collaboration on approaches to problem solving typically seen in children with Down syndrome**

We may conclude from the previous section that collaboration can have a positive effect on the problem solving skills of children with DS by operating at the cognitive level. However, the variable results from the naturalistic collaborative situation in Study 1 suggest that other factors may also intervene at a more affective level. In this study, a bi-directional effect was seen in some pairs in all three groups (DS, TD, NSLD). That is, while collaboration seemed to have a positive effect on outcome for some children, for others it had the opposite effect. This bi-directional effect at the individual level was also noted in the direct teaching condition in Study 3 and in the control groups of Studies 1 and 3.

The bi-directional effect seen in Study 1 suggests that in less structured collaborative situations several factors may play a role in outcome, including affective factors. At the most basic level, it was apparent that while some interactions were mainly of a positive nature, others were more negative. Whilst few children ‘collaborated’ in the sense of working together on the same part of the model, it became clear that in some dyads at least, collaboration was occurring in the sense of providing a supportive framework. This was achieved through some children actively facilitating the interaction through positive comments and praise and encouraging the partner to express their opinions. In this way, both children were kept on-task and interested and gained the support necessary to verbalise their own opinions. While facilitative behaviours on their own

were not correlated with positive outcomes, it is possible that they ‘paved the way’ for a potential positive outcome by keeping both children on-task and enabling dialogue.

A supportive framework may be beneficial to children with DS in particular as it helps to counteract some of the less productive approaches to learning that are commonly reported in this population. In Chapter 3 we noted that with regards to problem solving children with DS tend to exhibit certain behaviours that are common to the population as a whole. Despite this, there is little research that investigates collaboration in specific populations. As highlighted in Chapter 2, the research carried out in this area tends to group together children with different types of learning disabilities as if they were a homogenous population. This approach tells us little about how collaboration may impact on the learning difficulties associated with specific groups. In Chapter 3, we described some of the characteristic behaviours commonly associated with problem solving in children with DS. We will now go on to consider whether such behaviours appeared in the repertoires of the children with DS who took part in the studies in this thesis and to discuss how such behaviours might impact on, or be affected by, a collaborative problem solving situation. Much of the evidence for this will come from Study 1a, where a more qualitative analysis of behaviours was made.

### **9.3.1 The effect of a partner on task motivation**

Children with DS have often been noted to exhibit lowered levels of task motivation when compared to other children (Ruskin et al., 1994a). Lowered task motivation may manifest itself in a reluctance to engage with a task. Associated behaviours may include

going off-task more often, providing excuses for not engaging with the task and attempting to end a task session before the task is completed. Alternatively, it may include more subtle forms of task evasion. For example, Wishart (1988) has suggested that children with DS may attempt to evade challenging tasks through social diversionary measures such as locking gaze with the experimenter or producing “party tricks”. Pitcairn and Wishart (1994) also noted that children with DS produced more clowning behaviour once a task became challenging. Other researchers have noted that children with DS may have difficulty in switching gaze between an adult and a toy and may focus on the adult to the detriment of looking around the environment (Berger & Cunningham, 1981). Such behaviours may be deliberate on the part of the child with DS. Focusing on a person may absolve them from having to engage with challenges in the environment. In this way, a partner may actually be a distracting factor for the child with DS when a task is challenging.

In Study 1a there was little evidence that children with DS attempted to evade the task any more often than the children with NSLD or the TD children. There were no group differences in terms of the amount of time spent off-task and the group of children with DS did not make excuses for not engaging with the task, nor did they make more requests to end the task than the other groups. Neither was there evidence to suggest that the children with DS were using more subtle forms of task evasion. Whether the children with DS attempted to distract either the partner’s or the adult researcher’s attention away from the task through social means was investigated by measuring the amount of off-

task speech produced and occurrences and duration of eye contact. Children with DS as a group did not produce more off-task speech than the other groups of children who took part and group differences in eye contact were not found. From this, we might conclude that the children with DS in Study 1a did not give any particular indication of low motivation or a desire to avoid engaging with the task.

The lack of distracting behaviours seen in Study 1a may be related to the fact that the children in this study were generally older than the children who took part in studies where such task evasion strategies have been noted. Older children may not use such obvious means of task avoidance. Alternatively the presence of an active rather than a passive partner may be an influencing factor. In studies which have noted social-diversionary strategies in children with DS, the partner was invariably fairly inactive, in the sense that while they were administering a task, they were not actively involved in it (e.g. Wishart, 1988, 1993a, 1993b). In Study 1, both children in the dyad had joint responsibility for the task and were actively involved. This is a very different set-up to one where an adult simply 'administers' the task without actually playing an active role. In Study 1 there was no evidence of children with DS attempting to avoid the task. Neither was there evidence of task evasion in Study 2 (where both children again had joint responsibility for the task) or in the contingent instruction condition in Study 3 (where the adult and child worked together on the problem-solving items). However, in the control condition in Study 3 (and the direct teaching condition to a lesser extent) there was evidence of more covert means of task evasion. Some participants used

'pseudo-engagement' as a means of avoiding more difficult items. For example, once a participant reached a challenging item, he or she would simply reproduce the last solution they had made, over and over, regardless of the fact that it bore no resemblance to the spatial arrangement that they were attempting to replicate. In this way, the participant appeared to be engaged with the task, although they were avoiding engaging at a cognitive level. This 'pseudo-engagement' was most noticeable in the control group who simply repeated the task without help. Here, the adult partner was inactive in the sense that they simply observed the child completing the items. It was least noticeable in the contingent learning group where the adult and child were both active in completing the task. In this sense, the presence of an active partner may be particularly useful in terms of keeping the child with DS focused and motivated. Once the partner becomes inactive, the child with DS is more likely to disengage.

In summary, while the children with DS in this study did not appear to attempt to avoid the task through some of the more obvious means reported in previous literature, this may be age-related and design-related. Older children with DS may resort to more sophisticated means of avoiding cognitive challenges such as repeating strategies that worked for previous items. There was also evidence to suggest that the extent to which the partner is active may affect how well children with DS engage with a task. An active partner seems to encourage engagement, even with more challenging items, while the presence of an inactive partner is associated with task evasion.

Low motivation may also be associated with the concept of outer-directedness. Outer-directedness is described as the extent to which a person is dependent upon external praise or reward (Turnure & Zigler, 1964). There is evidence to suggest that children with learning disabilities, and in particular children with organic deficits such as DS (e.g. Yando & Zigler, 1971) are more outer-directed than TD children. The video-analysis from Study 1a presented no evidence in support of this point of view in terms of the number of requests for information, praise or confirmation made to the researcher. There were no differences amongst the DS, NSLD and TD groups in this respect. The majority of studies measuring outer-directedness in children with learning disabilities have looked at child-adult interactions. It is therefore possible that the presence of a child partner in the studies reported here directed attention away from the adult present and perhaps made the child feel more responsible for their own learning.

### **9.3.2 The efficacy of a partner with learning disabilities for children with Down syndrome**

Studies 1 and 2 in this thesis used a partner with learning disabilities for the children with DS. There is little existing research that has considered the effects of learning-disabled children collaborating together. As stated in Chapter 2, the majority of the research into collaboration in children with learning disabilities has concentrated on a peer-tutoring paradigm, usually with a TD partner and focus on children with learning difficulties rather than learning disabilities in the U.K. sense. From Study 1a there is evidence to suggest that the TD children may indeed have superior skills in regulating

social problem solving situations. They produced more facilitatory speech in terms of coaxing the partner to give an opinion, making positive statements and reminding the partner to stay on-task. Given the relatively young age of the TD children in the study, it is likely that this difference may have been even more pronounced had the TD children been matched for chronological age. However, this must be balanced by the fact that children with DS may be more at ease with other children with learning disabilities. Previous research has suggested that interactions between children with DS and TD children may be problematic, whereas interaction between learning-disabled children may follow a more natural course (Freeman & Kasari, 2002). Sinson and Wethrick (1981) suggested that children with DS might show abnormal gaze patterns when interacting with TD children. The fact that there were no differences between the TD and the DS/NSLD groups in terms of gaze suggests that gaze between learning-disabled participants follows a normal pattern.

Using peers with other learning disabilities may also have the advantage that the balance of power is relatively equal between the children. Children with DS may view a TD child in much the same way as they would an adult in terms of status or ability. In other words, they may simply assume that the TD child is more knowledgeable and this could block the equality of power necessary for constructive discussion to take place. It may also result in the child with DS simply agreeing with the TD child, without examining the validity of the ideas that the TD child has presented. Having an equal balance of power between the partners may also be an important factor in other ways. It was noted



in Study 1a, for example, that when one partner started to go off-task, they would often be reprimanded and brought back to task in a way that an adult partner might be reluctant to do. Thus, there may actually be less chance of children with DS attempting to 'charm' their way out of engaging with a task when with a peer partner.

It was also noted, however, that in peer partnerships where the balance of power seemed unequal that the collaboration could often take on a negative aspect. When one partner was very domineering, positive post-test outcomes were rarely seen. In some cases the dominant partner became increasingly directive and there was an increased incidence of negative speech such as insults, reprimands and blaming. This was a very different scenario to more balanced partnerships in which the collaboration seemed to provide an encouraging, supportive framework.

### **9.3.3 The problem of dialogue in children with Down syndrome**

Dialogue may play a large role in outcome in collaborative studies in two ways. Firstly, a partner must explain aloud his or her thinking in order for strategies for solving the problem to be made explicit. If the partner does not produce dialogue, the child must infer strategies from the child's actions - a considerably more difficult thing to do. Secondly, if the children concerned do not express their ideas and beliefs there is no basis for discussion. On an intra-individual level, the mere act of verbally expressing a thought may induce cognitive processing. The transition from thought to speech is neither automatic nor easy. It may be then that this process is conducive to learning in the sense that it allows more thorough processing of thought.

Studies 1 and 2 within this thesis underline the problems that children with DS in particular have with expressive language. In Study 1, the participants with DS spoke less overall and used a more restricted variety of speech forms than the other participants. Similarly, in Study 2 children with DS showed a reluctance to verbally express reasons for their conservation judgement. This reluctance to speak must surely have cognitive consequences. If one does not verbalise one's thoughts in public, it is easier to ignore inconsistencies in one's thinking. Often it is only when we promulgate our thoughts, so that they may be examined by others, that we can be reminded of their illogicality. A reluctance to verbalise thoughts may, of course, be directly related to the problems children with DS have with articulation and in developing expressive language. Again however, it may include a learned component in that if it is very difficult for others to understand us, we may become increasingly reluctant to invest the cognitive and linguistic effort necessary to help them to understand. Also, to reiterate from Chapter 7, if we never venture our opinion, we can never be shown to be wrong. While the problem may be physiological at source, there is no doubt that practice may be beneficial. If children with DS continually show reluctance to engage in dialogue, this could be a contributory factor in their falling IQ scores.

On a more positive note, observations made from Studies 1 and 2 concur with research by Franco and Wishart (1995) that children with DS may use non-verbal skills such as referential pointing to compensate for their poorer expressive language skills. In Study 1, children with DS frequently used pointing as a means of drawing attention to

discrepancies in the model and in Study 2, participants who were struggling with explanations for their conservation judgements would sometimes resort to non-verbal demonstrations. This is a compensatory skill which could perhaps be exploited in future research by introducing collaboration where non-verbal communication is a valid and integral part of the collaborative context. For example, in a study involving conservation, participants could be allowed access to scales, rulers etc in order to be able to provide non-verbal demonstrations.

The findings overviewed above indicate that collaboration could have a positive effect on the problem solving skills of children with DS at the cognitive level. The varied results of Study 1 also suggested that other factors within the collaborative interchange might also impact on the performance of children with DS at a more affective level. At the most basic level, it was apparent that while some of the peer interactions were extremely positive in nature, others were less so. However, whilst few dyads appeared to collaborate in the sense of working together on the same part of the model, it was clear that in some dyads collaboration was occurring in the sense of providing a supportive framework. This was achieved through some children actively facilitating the interaction through positive comments and praise and by encouraging the other child to express his or her opinions. In this manner, both children were kept on-task and interested and gained the support necessary to enter into a dialogue about the task. A supportive framework may be especially beneficial to children with DS as it may help to overcome

some of the less productive approaches to learning that are commonly seen in this population.

## **9.4 Locating the results within the existing collaboration literature**

### **9.4.1 Mechanisms for change**

While the investigation of collaboration in TD children has benefited from the existence of a comprehensive theoretical framework, research into collaboration in learning-disabled children tends to have been relatively atheoretical. Much of it has been outcome-oriented without any consideration of the processes involved. This thesis attempted not only to answer the question of whether collaborative problem solving may have positive benefits for children with DS, but also to consider to some extent how it might be beneficial.

In Chapter 1 we drew attention to the fact that two main theorists have been responsible for generating the majority of work on collaboration: Piaget and Vygotsky. The seminal works of both have led to approaches that have proposed very different mechanisms for what occurs during collaborative problem solving situations. The more individualistic Piagetian theory proposes that children are, in fact, architects of their own cognitive development. Accordingly, they must only be supplied with enough information to be made aware that their own state of knowledge is in some way lacking or incomplete in order for them to address it and attempt to form new structures and chains of logical thought. Theorists adopting this stance argue that the role of the partner in collaboration is simply to make the child reflect on inconsistencies in his or her own thinking, that is,

that coming into contact with another person may confront the child with a differing point of view which in turn promotes a cognitive disequilibrium. It is proposed that disequilibrium leads to epistemic curiosity as the child attempts to reach a new state of equilibrium through cognitive processing of the information available. This in turn leads to new structures being formed.

In contrast, Vygotsky and the socio-constructivists consider the child as an individual to be an insufficient unit of analysis. Instead, they proposed that development cannot be considered outwith the sociocultural context in which it occurs. All development occurs on the social plane, in the sense that our particular culture determines how development unfolds. From this viewpoint, higher psychological processes occur when a child works together with a more knowledgeable person. In this sense, collaboration may be likened to an apprenticeship whereby the apprentice gradually takes on more and more responsibility for a task until he or she is fully able to appreciate its cultural significance and complete the task unaided. While the aim of this thesis is not to test out any particular school of thought on collaboration, it is nevertheless fruitful to attempt to apply the two most common theories of collaboration to the results in order to gain possible insights into which processes might predominate in collaboration in children with DS.

In terms of Piagetian theory, there is some evidence for the role of socio-cognitive conflict in at least two of the studies undertaken. In Study 1 we have seen that the

children with DS and the TD children in particular used forms of speech which suggested that cognitive conflict had occurred. For example, they contradicted a partner's viewpoint, or defended their own point of view, or they pointed out discrepancies between their joint version of the model and the target model. All these speech forms indicate that the speaker was able to compare an internal model of one aspect of the problem-solving process to an external model, either a concrete model (the target model) or the internal model of another person, and through this comparison, to note discrepancies in the two models. In particular, using the target model as a point of reference was shown to be positively correlated with outcome. From this, we may conclude that cognitive conflict may be a feature of learning in children with DS, as it is assumed to be in TD children.

While this may seem to provide support for a Piagetian explanation of collaboration we might ask to what extent we might term this *socio*-cognitive conflict. In other words, to what extent has this process has been invoked by the social aspects of the learning situation? It is self-evident that certain types of speech such as defending one's opinion or contradicting someone else's opinion may only happen in a situation involving at least two people. However, using the target model as a point of reference was the only category of speech that correlated with positive outcomes. We must therefore consider the possibility that comparing a target model with one's own version of a model might be enough to invoke cognitive conflict without the presence of a partner being necessary. Teasley (1995) noted that it was not the presence of the partner per se that led

to gains in collaborative learning, rather it was the fact that two children working together often led to the types of speech which support learning being produced. When children working alone were asked to talk out loud, they also made gains, but not to the same extent as children who had worked in pairs. In Study 1 it was possible that comparing an own version of the Lego house to the target model version might have led to some gains (and possibly was a factor in the control groups of children who practised constructing the model without a partner). However, the favourable results seen in the groups of children who collaborated is likely to be due to the fact that pointing out inconsistencies would, in some cases, lead to further discussion.

In addition, we might conclude that the act of verbally expressing discrepancies is a factor in learning in that one might be aware of discrepancies when performing a task alone, but might not be able to see as clearly the discrepancies or indeed might simply choose to ignore them.

The design of Study 2 may be considered to be a classic Piagetian design in which two children with differing viewpoints (i.e. a non-conserver and a conserver) are brought together with the aim that exposure to a different opinion will lead to cognitive conflict and ultimately a better understanding of conservation. This was indeed the case, and a significant number of non-conservers improved their understanding of conservation after a collaborative session with a conserver. This could also be interpreted as providing support for the role of socio-cognitive conflict in positive collaboration outcomes.



However, as was noted in Chapter 1, not all theorists would agree on the interpretation of the mechanisms involved. Tudge (1990) has argued that such a design is actually more reflective of a peer tutoring type design as the children involved do not just have differing viewpoints (non-conserver and conserver) but one child is actually more advanced than the other in terms of conservation understanding. Viewed in this way, it could be argued that the impetus for cognitive change is not in fact socio-cognitive conflict but the factors which are thought to be salient in Vygotskian peer tutoring contexts. That is, the more experienced child helps the less experienced child by providing contingent help in his or her zone of proximal development. In this case, the variability in the results seen could be due to the competence of the peer tutor and there was indeed some evidence for this being the case. In the collaborative sessions some conserving partners provided more contingent help than others. For example, some conservers (C) would attempt to provide an explanation of conservation that operated on the justification given by the less advanced non-conserving child (N), as the following excerpt illustrates:

N: "The sausage has more [Playdough, than the ball has]."

C: "No, it doesn't – they've both got the same."

N: "The sausage has more – look" (holds hand to show length of sausage then demonstrates that the ball is narrower).

C: “Yes, but that one the sausage is just rolled long and thin. If you roll it back, it will be short and fat. You just think it’s got more because it’s longer, but it’s thinner too.”

This explanation may be considered to be contingent as it specifically mentions the reasons why the non-conserver believes that the sausage has more Playdough (because it looks longer) and uses this as a basis for explanation. Contrast this with the following:

N: “That one has more” (the sausage).

C: “No, it doesn’t – she didn’t add any or take any away”

Note that in this case, the conserver’s explanation is based around the notion of invariance (an amount does not change, unless we add to it or subtract from it) while the nonconserver had based his justification around perceptual appearance. The level of the conserver’s explanation does not relate to what the non-conserver said and is at too high a level for the non-conserver to grasp. In this case, the conserver is not working within the zone of proximal development of the non-conserver. Thus while cognitive conflict may indeed be a factor in determining whether cognitive growth takes place or not, there may be different levels of cognitive conflict in terms of how much information it provides and the extent to which the information is contingent upon the child’s level of understanding.

The results from Study 3 provided further evidence that contingent instruction - that is instruction which operates at the child's current level of thinking - may be superior to other types of instruction on certain tasks. From the point of view of Vygotskian-driven research, this is explicated through the zone of proximal development. The partner continuously monitors the child's level of understanding in order to provide instruction that remains one step ahead of the child's level of understanding, while allowing the child to take responsibility for those components which he or she is able to manage. As noted previously, the contingent learning condition in Study 3 was the only condition which produced unidirectional positive results. In Studies 1 and 2 peer partners were used who were likely to be less skilled in providing instruction that was contingent and the results seen were more variable. It could be argued therefore that more consistent results were seen in the contingent learning condition in Study 3 because the peer partners in Studies 1 and 2 did not attempt to teach the other child. Consequently, no explicit guidance was given and participants would have had to infer much of the information they gained from the actions of the partner. Obviously, when information is made explicit rather than implicit, there is less scope for misunderstanding. However, this must be tempered by the fact that the direct teaching condition in Study 3 did attempt to teach and made solutions explicit. The major difference between the two conditions in Study 3 was that one condition was contingent on the child's current level of understanding and one was not.

As well as upholding the positive benefits to be gained from working within the zone of proximal development, neo-Vygotskians emphasize the role of equality and reciprocity (e.g. Ellis & Gauvain, 1992; Forman, 1987). There was an indication that reciprocity and consensus might play a role in positive outcomes, although this could not be tested statistically. It was noted in Study 1, for example, that in partnerships where one partner was very domineering, the outcome was often poor. Better results were seen when both children were active in contributing to the collaboration. This could explain some of the inconsistency in results seen in that particular study. While speech indicative of cognitive conflict appeared more in the DS and TD groups, it was not correlated with outcome. We may therefore tentatively propose that the quality of the interaction in terms of how well the two children worked together may also be a contributory factor in outcome.

#### **9.4.2 Reconciling Piaget and Vygotsky**

While this thesis did not set out to examine the effects of collaboration from a specific theoretical viewpoint, it is useful nevertheless to draw on available theory in order to arrive at a more comprehensive account of what happens in collaborative problem-solving in children with DS. In order to tie together the studies within this thesis, an attempt will be made to reconcile the theories of Piaget and Vygotsky by fitting them into a larger framework. While neo-Vygotskian theory has tended to concentrate on interactions between adults and children and neo-Piagetian theory has revolved around the notion of peer interaction, we may reconcile the two theories at a different level by

looking at the similarities in the processes implicated in both theories, regardless of the partner.

At a number of levels, there are similarities between both the theories of Piaget and Vygotsky which apply to the studies in this thesis. The following areas are considered:

- responsibility for the task
- cognitive conflict as a precursor to cognitive change
- the extent to which instruction is contingent
- collaboration as a supportive framework.

#### *Responsibility for the task*

One factor common to both Piagetian and Vygotskian theory is a strong notion that children's learning must be driven by their own motivation. This is, of course, particularly emphasised in Piagetian theory. In order for this to occur, the responsibility for the task must lie mainly with the child. In peer collaboration designs, the equality of power between the peers involved allows them to maintain a sense of responsibility for the task. When a child collaborates with an adult there is perhaps more risk that the child will absolve him or herself of responsibility for the task. This should not occur to the same extent in situations where the instruction is contingent. During contingent instruction, the responsibility for the task is shared by both the child and the adult but it is the child who determines which parts of the task are to be handed over to him or her and at which point. Thus the control of the task still clearly lies with the child. This

stands in stark contrast to more didactic forms of teaching, where control of the task clearly lies with the 'teacher'. Note that this is closely bound with notions of power and ability. In more directive teaching activities, it is apparent that the teacher is more able than the child being taught, regardless of whether the teacher is an adult or a child tutor. In such situations the child who is being taught does not have to take primary responsibility for the task and this may be reflected in a lack of motivation.

### *Cognitive conflict as a precursor to cognitive change*

The proposal that cognitive conflict is a precursor to cognitive advancement has been traditionally allied to a Piagetian theory of development and has not appeared in Vygotskian accounts of collaborative learning. It is possible, however, to see evidence for the notion of cognitive conflict within theories of development based on instruction within the zone of proximal development. When instruction is within a child's zone of proximal development (i.e. when it is contingent upon the child's actual level of understanding), the partner's role is not to demonstrate a solution. Instead, working on the basis of the child's current knowledge, the instructor encourages the child into reflecting on the suitability of his or her current strategies for completing the task. Thus we might think of contingent instruction, in some instances, as a type of cognitive conflict. The objective is not to model a solution; rather it is to invoke cognitive processing within the child, which may lead to advancement in understanding. The following is an excerpt from a conversation between the adult researcher and a child with DS in the contingent learning condition in Study 3:

(Child has made an incorrect version of item)

A: "Well, you've done quite well, but.. what do you think?"

C: "It's not the same."

A: "What's not the same?"

C: (Comparing own version to picture) "Hmm... those bits ..they're not right."

A: "Can you change them?"

C: "Yeah... (starts to turn squares into triangles but still don't fit because middle piece is incorrect)...oh, no. I can't do it."

A: "Do you have to change something else first?"

C: (Compares the picture and own version for some time). Yes!! Change that bit first!"

(Child was able to successfully complete task).

Note that alongside providing hints, the instructor allows time for the child to compare the two versions and process the information. This allows the child to retain responsibility for the task and rely on his or her own internal thought processes to work out a solution. Van der Veer and Valsiner (1991) have suggested that the common belief that Vygotskian theory of cognitive development is based on intersubjectivity rather than individualistic processes may have been overstated and that, in fact, Vygotsky saw 'higher order thought' as an individual property. Thus from the perspective of both



Vygotsky and Piaget, showing a child a solution to a problem is inferior to allowing the child to arrive at the solution by him or herself.

### *The extent to which instruction is contingent*

Conversely, contingent instruction is a notion which is commonly associated more with Vygotskian theory than with Piagetian. However, we have seen from the discussion of Study 2 in the previous section, that when a partner expresses a difference in opinion, it may be expressed more or less contingently, depending on the ability and motivation of the partner. The more the partner operates on the previous thinking of the other child, the more contingent the explanation will be. Such utterances may be at exactly the right level for the other child to understand. This may explain the finding that children who are just slightly ahead in terms of ability may be better partners than children who are much further ahead (Mugny & Doise, 1978). Children who are only slightly ahead may still understand the reasoning of a less able child, whereas a much more advanced child may not be able to understand the reasoning of a less able child and may therefore provide an explanation that is too sophisticated.

### *Collaboration as a supportive framework*

Both Piagetian and Vygotskian theory touched on the role of affective factors in cognitive development (e.g. Piaget, 1981b; Vygotsky, 1994) although it has featured far more strongly in neo-Vygotskian accounts (e.g. Wood, Bruner & Ross, 1976). Whilst argument and discussion seems to be an important feature of collaboration, especially

when partners are peers, it is apparent from all three studies in this thesis that a supportive framework is an important feature in influencing cognitive outcomes. By this it is meant a framework, in which children feel comfortable expressing opinions in the company of supportive peers, are helped to stay on-task and are more highly motivated to work on the problem.

The studies within this thesis did not attempt to provide evidence for any one theory of collaboration. However, it is apparent that evidence in support of the mechanisms proposed to drive change in the theories of both Piaget and Vygotsky may be found in more than one study. This can be reconciled by the fact that, at certain levels, the theories of Piaget and Vygotsky may be considered as complementary.

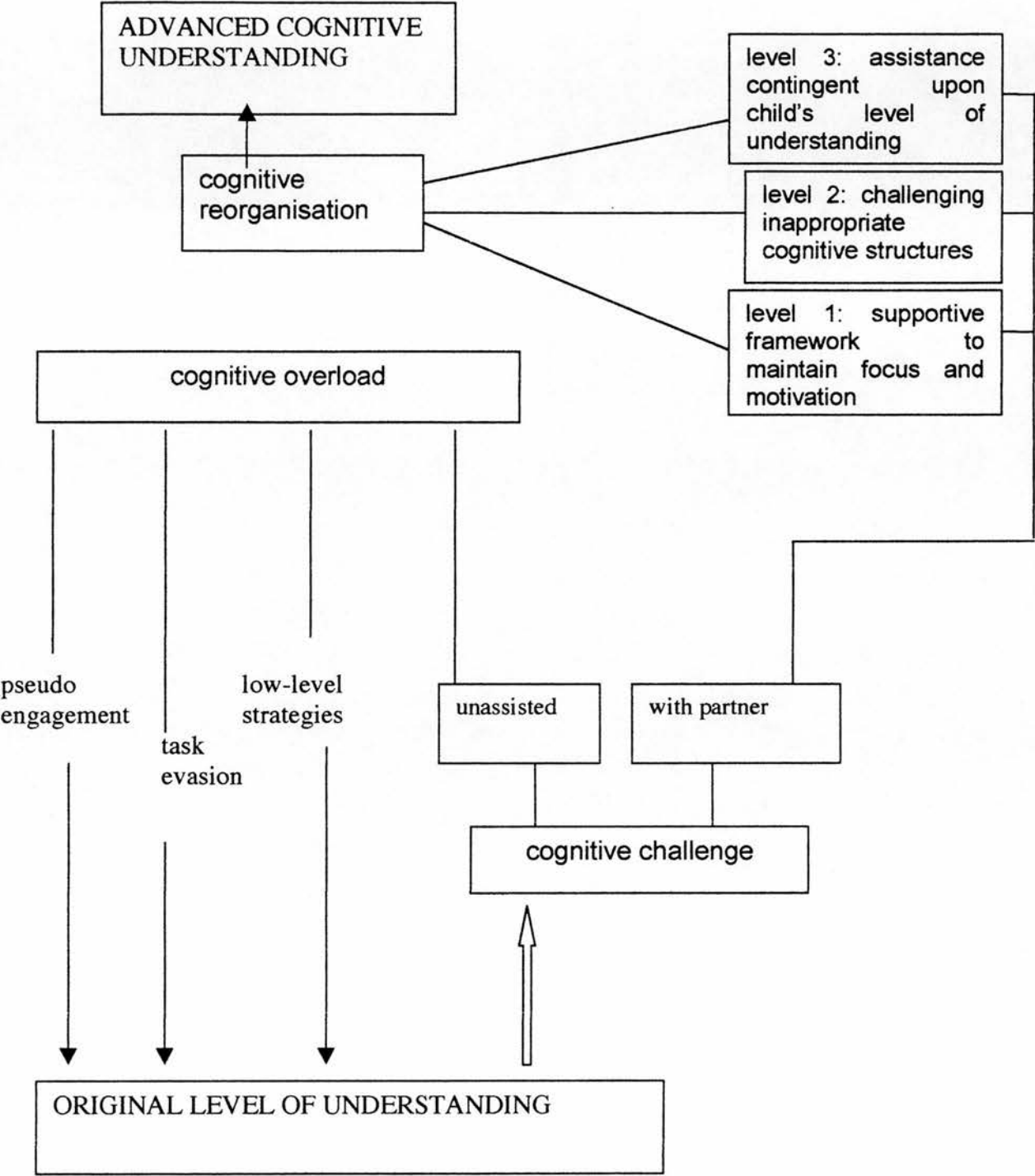
## **9.5 Fitting children with DS into a framework of collaborative learning**

In the previous section, we have seen how different theories of collaboration may be drawn upon when explaining collaborative outcomes in children with DS. This section will now hypothesise how the different features of collaboration may operate on the problem-solving behaviours typically seen in children with DS. Figure 9.1 illustrates how collaboration might help to break negative cycles of problem-solving approaches in children with DS.

The original level of understanding is a level with which the child is comfortable. For example, on a conservation task, it could be the explanation that a ball has more

Playdough in it than a pancake because it looks taller. In the case of copying a design, it could be the knowledge that two small triangles can be put together to make a large triangle. When the child is faced with a problem that challenges this view, he or she is thrown into a state of disequilibrium whereby the new facts do not fit well with the child's current level of understanding. For example, the child may listen to another child state that the ball and pancake have the same amount of Playdough despite the fact that they appear perceptually to be different amounts. In a design-copying task, the child may be asked to turn the two small triangles into a square which causes conflict as the child has previously only turned them into a large triangle.

Figure 9: Hypothetical model of the effect of collaboration on children with Down syndrome



The struggle to reconcile conflicting information requires a great deal of cognitive effort and when children with DS are faced with a cognitive challenge without support, they may lack the motivation to process the necessary information and may instead choose to simply ignore the cognitive dissonance presented by the situation. Indeed, Wishart (1991, 1993a, 1996) suggests that children with DS become increasingly reluctant learners through repeated experience of learning failure. They may do so by using task evasion strategies which avoid engagement with the task, or may simply cling on to their original strategy for dealing with the situation. In the case of the non-conservers faced with the differing opinion of the conserver, the child may simply choose to ignore the conflicting information; in the case of copying blocks they may doggedly turn the two smaller triangles into a larger triangle even when a square is required. By refusing to engage with the task on a cognitive level, the child circumvents the need to process difficult or challenging information. Ultimately, avoiding cognitive challenges means that the child's original level of understanding does not change as the child is effectively foregoing opportunities to consolidate new learning.

This hypothetical model stands in contrast to the outcome seen under certain conditions in the collaboration studies reported in this thesis. In many cases, there was evidence that cognitive processing was taking place and, in Studies 2 and 3, that a change in cognitive structures had taken place. So what factors might have led to this outcome that would not have been present in a learning situation in which the learner was working on his or her own? Collaboration with a partner may work at several different levels,

depending on the nature of the task and the efficacy of the partner. At its most basic level, collaboration may work by preventing the child going off-task. The presence of a partner may help to keep the child with DS task-focused. Secondly, at the affective level, collaboration may provide a supportive framework which prevents the child from being overwhelmed by the task demands. This may explain partly why the control group in Study 1 appeared to benefit somewhat from the mere presence of a supportive adult over the series of sessions. Being in a supportive environment may encourage the child to retain responsibility for his or her learning. Lastly, collaboration may to a greater or lesser extent be contingent upon the child's current level of cognitive understanding and the extent to which learning takes place in the child's zone of proximal development. This, of course, may vary depending on the skill of the partner. Thus it might be said that the most effective and consistent collaboration would occur when the partner present is supplying a supportive framework, as well as assistance that is contingent on the child's level of understanding. This need not necessarily be a typical adult-child teaching paradigm. It may simply involve a peer who engages in discussion at a level that the child can understand or who presents an opposing view that is explicitly linked to the child's own view.

We may conclude that the most consistent and positive outcomes from collaborative learning opportunities will be seen when all three conditions reported in Figure 9.1 are fulfilled. That is the partner supplies a supportive framework to keep the child on-task and motivated and supplies contingent assistance while at the same time challenging

inappropriate cognitive structures. This could explain the very consistent and positive results seen in the contingent instruction condition in Study 3. However, all 3 levels do not have to be present for collaboration to be beneficial. Even if contingent instruction is not a feature of the collaboration, or if cognitive conflict does not arise, participants may still benefit to a certain extent from a supportive environment and being kept focused on the task.

## **9.6 Implications for the education of children with DS**

Vygotsky argued that no matter what the cause of learning disabilities, the consequences were social in that:

“all contact with people, all situations which define a person’s place in the social sphere, his role and fate as a participant in life, all the social functions of daily life are reordered” .

(Vygotsky, 1987, p.12)

In other words, all learning disabilities will have direct and indirect consequences.

Direct consequences arise as a result of physiological or biological features associated with that particular learning disability, whereas indirect consequences will arise as a result of the way that the learning disabilities are viewed by the environment. This viewpoint is particularly germane to DS as it is a syndrome which is easily recognised



by the layperson and with which a strong stereotype is associated (Wishart & Johnston, 1990).

With regards to teaching the child with learning disabilities within their zone of proximal development, Vygotsky argued that adults tend to focus on the actual level of the child's development and thereby omit to provide assistance leading to the development of higher-order psychological processes. Consequently, it is easy to see how any problems with learning inherent in certain learning disabilities might be further exacerbated by the influence of the environment.

This is a point well illustrated by the lack of research into collaboration in children with learning disabilities. There seems to be a pervasive view that collaboration as a means of cognitive advancement is suitable only for higher-functioning children and that the demands it makes will be too high for children with learning disabilities (Stone, 1998). This is evidenced by the fact that studies of collaboration in 'learning-disabled' children tend to focus on groups of children with specific academic difficulties, children with speech and/or behavioural problems or children with only mild learning disabilities. The assumption seems to be that one needs almost normal intelligence to be able to benefit from such a 'complicated' form of learning. Ironically, while collaboration has been shown to be an extremely effective way of improving problem-solving skills in TD children, it is being denied to those who may need it most: children with deficient problem-solving skills.

Where children with more substantial learning disabilities have been investigated, the research retains very much a didactic flavour in that TD children are often employed to see if they can 'improve' the social skills or academic skills of the learning-disabled child. There are few studies which address metacognitive skills in children with learning disabilities. Such a paradigm still operates on the principle that children with learning disabilities may be teachable but they are not in a position to take the responsibility for their own learning.

In contrast, the results from this thesis clearly indicate that collaboration may be as suitable a forum for learning for children with DS as it is for TD children. In addition, there is evidence to suggest that the same mechanisms drive cognitive advancement in collaborative situations as have been suggested in the TD literature. From this, we might assume that children with DS can take a greater degree of responsibility for their learning and, given the right circumstances, be intrinsically motivated to learn. It is this intrinsic motivation that leads to cognitive restructuring and which may ultimately be a useful tool in addressing the consolidation problems commonly seen in children with DS.

As well as indicating that children with DS may potentially benefit from collaborative problem solving, Studies 1 and 2 indicate that peers may be suitable partners. This is an important pragmatic point given that opportunities for extended one-to-one adult/child collaboration may be infrequent in any school. The fact that the peer partners in the

studies reported here also had learning disabilities is a particularly salient point, given that many children with DS are being educated in separate provision schools in Scotland and other parts of the U.K. at the current time. Using learning-disabled peer partners may in fact have considerable advantages in terms of maintaining a balance of power between collaborating children.

Study 3 indicated that a sensitive adult might provide the right level of instruction to bring about consistently positive outcomes. One big advantage that contingent teaching with an adult partner has over peer learning is that an adult can provide a framework for the child to be able to understand smaller steps in the task before he or she is aware of their full significance. It is unlikely that peer partners would always have the skill to do this effectively. Thus, on tasks where a strategy for completing the task is required, an adult may be a more useful partner. It should be noted, however, that this in no way implies that a significantly more competent partner is needed for children with learning disabilities. It is apparent from Studies 1 and 2 that a peer may be a suitable partner for other tasks in which it is important that the balance of power is such that one child is not overpowered by the other child so that no reasonable discussion can take place. Thus the choice of partner should be carefully considered in relation to any problem-solving task. For example, peer partners may be an ideal choice when discussing scientific concepts such as number or biological concepts or moral issues, while contingent teaching may be more appropriate for tasks where the significance of the solution might not be immediately obvious to the child, e.g. when copying designs.

While the studies described in this thesis cast doubt on the notion that the learning-disabled child will always learn best from an adult, they also question the assumption that a TD child will be the most suitable peer partner. The results from Study 1 indicated that TD children might be more facilitative in collaboration with one another. However, there is no reason to suppose that this would outweigh the benefit of working in partnerships where the balance of power is equal. For example, in conservation studies, it may be speculated that a child with learning disabilities might view a TD child in the same way that they would view an adult, that is, they might simply assume that the TD child was more knowledgeable and would agree with whatever had been said, without going through the process of examining their own beliefs and knowledge. There might then be a danger that the less able child would simply adopt the viewpoint of the more able child but without any associated cognitive re-processing. Obviously, this situation would be unlikely to lead to any real or consolidated learning. Further research is needed however, if such processes are to be better understood.

In overview, we might propose that collaborative problem solving is a suitable forum for learning in children with DS, even with learning-disabled partners of around the same level of ability. In other words, it is not essential that a more able partner leads the interaction.

## **9.7 Cautions**

On a cautionary note, while collaboration generally had a positive effect on the learning outcomes of children with DS, Study 1 gave an indication of what might occur were children asked to collaborate in a fairly unstructured situation without adult guidance. While some children coped well with the experience and benefited from it, it was apparent that for some children it was not a particularly positive experience. In the absence of guidelines or rules, some children became rather domineering or aggressive. This was characterised in some dyads by a high preponderance of negative speech such as insults, reprimands and blaming. In children with DS whose perception of themselves as learners is likely to be fragile in the first instance, this could be very damaging. It would therefore be prudent to train children in working together prior to the collaboration and also to have a set of guidelines in operation during the collaboration, e.g. no negative comments, no physical conflict etc. In addition, the co-operativeness and sociability of the potential child partner may be a consideration in forming pairs.

## **9.8 Limitations and implications for future research**

In comparison to much of the literature on collaboration in TD children, the sample sizes in the studies that comprise this thesis are inevitably relatively small. While the extent to which findings of studies with smaller sample sizes can be generalised is clearly limited, this is counterbalanced by the careful matching procedures employed which strengthen, to some extent at least, the claims that may be made. The smaller sample sizes reflect the logistical and practical difficulties of working with children with learning disabilities.

Working with a specific etiological population, by its very nature, reduced the number of available participants, while the necessity of matching participants further constrained sample size. Researching such children in special provision schools is also especially time-consuming as children often have individualised timetables thus the co-ordinating timetables of two children in order that they may work together can be extremely difficult.

Whilst all the children with DS in this study were being educated in separate provision, they nevertheless reflected a wide range of children with DS both in terms of their levels of cognitive ability and socio-economic backgrounds. It was decided to test only children who were being schooled entirely in separate provision after original consent letters sent out via the Scottish Down Syndrome Association indicated that, despite a formal policy of mainstreaming for children with DS in the local authorities involved, the overwhelming majority of children with DS in the Lothians area were being schooled in separate provision. Including the small numbers of children who were in mainstream schools would have been additionally time-consuming, in that it was not likely that there would have been more than one child with DS in any given school and the time spent travelling would have increased considerably. In addition, finding TD children in the same school who were either the same or only slightly higher ability than the children with DS would have been extremely difficult, given that differences in chronological age would most probably have been very large.

The studies comprising this thesis were of cross-sectional design. It could be argued that valuable information could have been obtained from a more longitudinal design which could have provided information about the longer-term outcome of collaboration. However, it was felt that the lack of relevant research into collaboration in children with DS, in conjunction with the generally atheoretical approach to collaboration in children with learning disabilities, warranted a more exploratory approach. Such an approach ensured that the thesis did not become overly outcome-oriented and allowed some leeway for commenting on the relevance of the studies to the existing collaboration literature.

With regards to implications for future research, it would be informative to expand the types of research design used in this thesis into workable programmes which could be implemented as one-off studies in which a larger number of children with DS participated. For example, the conservation studies could form the basis for looking at group number work in children with DS. In the TD literature much research is now being undertaken into group work in classrooms (e.g. Howe and colleagues, 1995, 2001) and this is a possible avenue for future research in separate provision schools, especially with regard to number, science and biology teaching. Alternatively, research into paired learning would be informed by studies looking at the efficacy of trained peers. In this thesis, untrained peers were used in order to provide information of how peers would act in a fairly naturalistic setting. However, trained peers might well be extremely effective as a tool for education purposes.



The studies comprising this thesis were based on participants attending special provision schools. There is some evidence to suggest that children with DS who attend mainstream schools rate higher on grammar comprehension and receptive vocabulary measures relative to chronological age-matched children with DS attending special schools (Laws, Byrne & Buckley, 2000). It could be speculated therefore that children with DS in mainstream settings might benefit more from collaborative learning situations on the basis of their higher language skills. This is another area which would benefit from further investigation.

## **9.9 Overview**

This thesis set out to explore the effects of collaborative problem solving on cognitive outcomes in children with DS and to relate the findings to the extensive literature on collaboration in TD children. Through three separate collaborative studies and through qualitative as well as quantitative analysis it was possible to provide an overview of how children with DS might react in collaborative problem solving situations and findings indicate that collaboration may have positive effects on the cognitive processing of children with DS.

The findings have also confirmed that theories of learning through collaboration in TD children may have validity for children with DS. This implies that future research into collaborative problem solving can legitimately follow a similar course to that seen in the TD literature. Specifically, the optimal environment for successful collaboration could

be considered along with research into how collaborative work might best be integrated into everyday educational settings.

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## APPENDIX A

### ETHICAL ISSUES

#### A1 Introduction

Ethics must be a consideration of every study involving people but it is a paramount consideration for studies involving children. The British Psychological Society (BPS) Code of Conduct (2000) was adhered to at all stages of both the design and implementation of the research. In addition there were a number of issues particularly pertinent to this thesis which had to be taken into account. Conducting research into children with learning disabilities poses certain ethical dilemmas, as does conducting research in a school setting.

Morrow and Richards state that “the biggest ethical challenge for researchers working with children is the disparities in power and status between adults and children” (1996, p.98). Added to this is the factor that when conducting research in school settings, children often assumed that the researcher has the same status as a teacher and assume that the experimental situation is a part of the school curriculum. When children with learning disabilities are the participants, the imbalance in power is even more pronounced. Special precautions must be taken to ensure that the child with learning disabilities is afforded the same rights as other persons to agree to or decline to take part in research projects. All of these factors were taken into account when planning and conducting the research as outlined below.

#### A2 Informed consent

One of the most common factors in ethical considerations is the need to gain informed consent. This means ensuring that participants understand that they have the right not to participate, or in other words steps must be taken to ensure that all participants are truly volunteers. When children are involved, consent is usually obtained from parents or guardians. Tymchuk (1992) notes however, that there exist a distinction between consent and assent. *Consent* may be thought of as the process whereby the adult agrees to the child participating in a research project, the assumption being that the child is not competent to give informed consent. The child then *assents* to becoming a participant. Ethically, this process is somewhat unsatisfactory. Boyden and Ennew (1997) suggest that participation can mean either ‘taking part’ or being present, or it can mean knowing that one’s actions are relevant and may be acted upon. While it is somewhat more problematic to obtain informed consent from children with learning disabilities due to their ability to understand the research process, it is not impossible, if explanations are pitched at the level of the child’s competence. At the very least, participants should have the opportunity to express ‘informed dissent’ (Morrow and Richards, 1996).

In the studies relating to this thesis, parental permission was sought through the individual child’s school. Each parent or guardian received detailed information about the design and aim of each study individually. Parents were then requested to return a

signed form if they agreed to their child participating. If they did not wish their child to participate they did not return the form. While this method entails more effort on the part of the parents than requesting parent to respond only if they object, it ensures that participants do not take part because their parents have forgotten to return the form. After parental consent had been received, the researcher visited the school and discussed the project with each child individually. The basic aims of the project were discussed at a level that each child could understand. No mention was made however, of the fact that the project aimed to compare the performance of groups with different etiologies of learning disabilities as it was felt that danger that this might be upsetting to the participants outweighed the benefits of disclosing the information. This was especially true of the children with Down syndrome, as the researcher would not have been able to ascertain to what extent the children were aware of having the syndrome, or indeed what it meant in terms of behaviours and ability.

Instead the children were made aware of the nature of the task in terms of whether collaborative learning was beneficial. Each child was then asked whether they would like to participate, whilst making it clear that they were under no obligation to do so. They were also made aware, as far as possible, that the results were being noted and that they would be available to be read by others afterwards, albeit without mention of the child's identity.

As was mentioned above, there may be an implicit imbalance in power between researchers and participants and this is more pronounced when the participants are children with learning disabilities. Several steps were taken to lessen this effect. Firstly, the participants were informed that they could finish the task at any time or refuse to come out of class if they did not feel up to the task on that particular day or if they had specific school activities which they did not want to miss. In fact, several children did exercise this right. The imbalance in power can be particularly salient when testing takes place in school settings as participants often assume the researcher to be an equal of the teacher in terms of having authority. The participants were reminded that the researcher was not a teacher and that the sessions that took place were not a test and furthermore that there were no right and wrong answers. If the participants asked questions throughout the task, the researcher took the time to answer each question fully.

When the participants were collected from classrooms, the researcher spoke to the teacher first, then asked the participant directly whether they were ready to volunteer. Finally, at the end of each session, the researcher thanked each participant for helping. Each of these steps was taken to ensure that the participant understood that that they were volunteers and that they were able to exercise their right to decline to take part.

### **A3 Sensitivity to the participant as a person**

Taking part in psychological research may be a fun and rewarding experience for some children; for others it may be psychologically damaging in terms of the child's self-concept and self-esteem. Again, this is exaggerated in children with learning disabilities



who may have had a negative history of testing experiences. For these reasons, it was important that the researcher conveyed the impression that the child's input was valued and that praise and encouragement was given where possible. Often, the participants came to view the researcher as a friend and under these circumstances, expected some off-task conversation and that the researcher show an interest in what the child had been doing outside the test session. It was therefore important that some time was reserved for this and that the child was not simply rushed in and out of the testing room, thus making it clear that their purpose was simply to complete the task.

As stated above, participants were not informed that the project compared the performances of children with different etiologies for their learning disabilities to typically-developing children and steps were taken to ensure as far as possible that this information was not relayed via teachers. As the research was conducted in special schools, this was not a major problem, although it was important to ensure that participants did not feel singled out because of the aetiology of their learning difficulties. Accordingly, the research did not discuss such aspects of the study in the presence of pupils and teachers were requested not to identify children in class by the aetiology of their learning disabilities.

As the research took place during school hours, steps were also taken to ensure that testing caused the least disruption to the participants' education. The timetable of test sessions was discussed at length beforehand with individual teachers to ensure that participants did not miss what the teacher considered to be core lessons. In addition, attempts were made to avoid testing during non-core lesson activities which the teacher felt were particularly enjoyable or beneficial to the participant such as swimming.

Greig and Taylor (1999) note that some children can be hurt by being excluded from a research project. This was especially apparent once the researcher had made regular visits to the same school over a period of time. In these cases, the researcher spent some time with the child either playing with the Lego or doing a small component of one of the sub-tests, for example, mazes from the WPPSI.

#### **A4 Task feedback**

Solberg (1996) makes the point that children in schools are used to having their responses defined as right or wrong and that it may need to be made clear to children that certain tasks within a research project do not have 'correct' or 'incorrect responses as such. This was particularly relevant to sessions which involved testing on IQ battery sub-tests. Although the participants were informed before sessions that the session was not a 'test', the majority asked for feedback on their performance. The researcher then provided the participant with details on how many test items they had completed correctly, without reference to the possible score. Praise was also given where the child had applied him or herself particularly well or where the child had attempted difficult problems.

### **A5 Debriefing**

At the end of any research project it is important to discuss the process with the participants in order to make sure that there have been no unintended or unanticipated adverse effects of participating in the research (Barrett, 1995). After the completion of each individual study, the researcher asked each child whether they had enjoyed participating in the study as a way of beginning a conversation. Each participant was then given time to ask any questions that they felt were relevant.

### **A6 The right to confidentiality**

Parental consent forms ensured the following: that no child would be identified individually in any subsequent report or presentation, and that information regarding test scores or similar would be viewed only by the researcher and those directly involved in the research (i.e. supervisors). The names of the participants involved were not disclosed at any stage. Greig and Taylor (1999) note however, that even when names are not disclosed that identities may be identified by readers who have specialist knowledge of the separate provision schools in a certain area. Participants may then be identified by their age and gender. Although this is unlikely, it is unavoidable as there is a need to report both chronological age and sex.

As many of the test sessions in the thesis were based around sub-tests of commonly-used IQ tests, some teachers requested information on how individual children had performed. Disclosing such information would not only have been a breach of confidentiality, it would have been misleading given that full IQ tests were not administered and given that the researcher was not qualified to interpret test results in terms of IQ. When such occasions did arise, the researcher gave only non-specific feedback in terms of how well children had applied themselves to the task and how enjoyable they had found it.

### **A7 Protection of the child participant**

Before the data collection began, the researcher underwent a police check via the University of Edinburgh. All sessions where the participants were alone with the researcher were filmed for the safety of both the child and the researcher. Video-recordings of pre- and post-test sessions were stored appropriately, while recordings of collaborative test sessions were viewed by the researcher only.

### **A8 Overview**

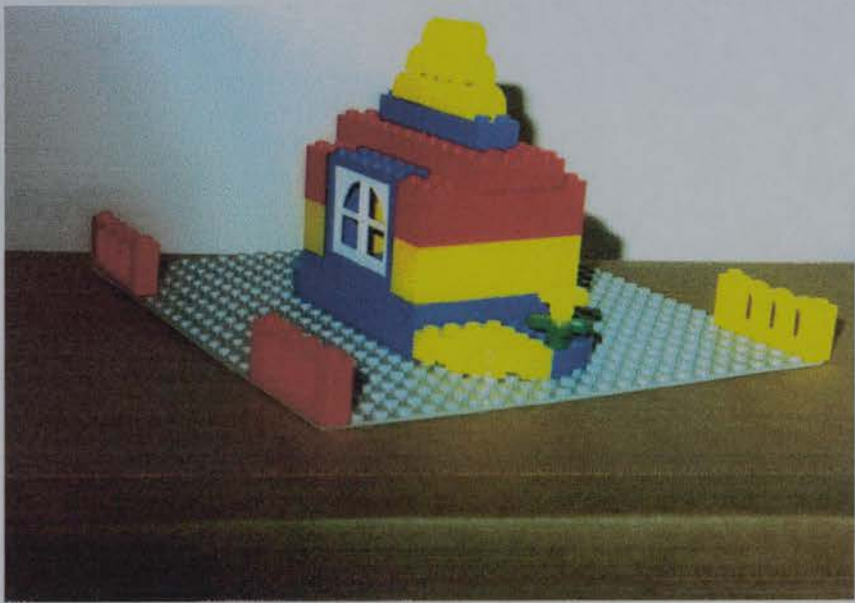
As the research in this thesis was concerned with children and took place in school settings, ethical procedures were put in place to ensure that the participants were volunteers. Particular attention was paid to the participants with learning disabilities to ensure that their level of competence did not interfere with their rights as a participant under the BPS code of conduct.

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APPENDIX B

FRONT AND SIDE VIEW OF TARGET MODEL LEGO HOUSE



## APPENDIX C

### NON-VERBAL SUBTEST FROM THE WPPSI-R

Recommended age range: 3 years to seven years, 3 months

sub-test	description
Block Design	This requires the child to analyse and reproduce, within a specified time limit, patterns made from flat, two-coloured blocks.
Geometric design	This includes two distinct types of tasks. The first are visual recognition tasks. The child looks at a simple design and with the stimulus still in view, points to one exactly like it from an array of four designs. On the remaining items, the child draws a geometric figure from a printed model.
Mazes	This requires the child, under time constraints, to solve pencil-and-paper mazes of increasing difficulty. Several simpler mazes at the beginning of the subtest make the task more suitable for very young children.
Object assembly	The child is presented with the pieces of a puzzle arranged in a standard configuration. The child is required to fit the pieces together to form a meaningful whole within a specified time limit. The subtest is modelled on the Object Assembly subtests of other Wechsler intelligence scales, but the WPPSI-R puzzles are printed in full colour.
Picture completion	This requires the child to identify what is missing from pictures of common objects or events.



**APPENDIX D****NON-VERBAL SUBTESTS IN THE WISC-III**

Recommended age range: 6 years to 16 years, 11 months

sub-test	description
Coding	The child copies symbols that are paired with simple geometric shapes (Coding A) or with numbers (Coding B). Using a key, the child draws each symbol in its corresponding shape (Coding A) or under its corresponding number (Coding B). The child's score is determined by the number of symbols correctly drawn within the 120-second time limit.
Block Design	This requires the child to analyse and reproduce within a specified time limit, patterns made from flat, two-coloured blocks.
Mazes	The child is required to solve a series of mazes. In each maze the child is required to draw a line from the centre to the exit without entering any blocked passages or crossing through walls. The task is timed to determine how quickly the child can correctly complete the maze.
Picture completion	For each item, the child is required to look at a picture and name or indicate by pointing the important part that is missing from the picture. The child must respond to each item within a 20-second time limit.
Symbol search	In this subtest the child must visually scan two groups of shapes and indicate by marking a box whether any shapes are common to the groups within a 2 minute time limit.

## APPENDIX E

### SCORING PROTOCOL FOR THE WPPSI-R AND THE WISC-III

The usual method of scoring the WPPSI-R for typically-developing children is as follows: after the items of each WPPSI-R subtest have been scored, the examiner must determine the child's raw and scaled scores on the subtests, and the Verbal, Performance and Full Scale IQs. Obviously, it was not possible to follow the usual procedure to obtain a full scale IQ in this case, as only the performance subtests had been administered. The raw scores are normally converted to scaled scores appropriate to the age of the child. The WPPSI-R was developed for use with children between 3 years and 7 years 3 months of age and scaled scores and IQ norms are provided for these ages only. The majority of participants with learning difficulties were above the upper chronological age limit and thus the performance of children outside this range may only be described in terms of "test ages". In order to have consistency across participants, this method of scoring was employed for the typically developing children also, although it would have been possible to obtain a standard performance measure for these children based on chronological age norms.

Obtaining a test age in this manner compares the child's scores on the WPPSI-R with age norms of other scales. Test ages were determined by finding the raw score reached on the subtest by looking in the appropriate column for that subtest, then finding the corresponding test age for each subtest. An overall test age was obtained by summing the test ages and dividing by the number of subtests. Performance sub-tests of the WISC-III were scored in a similar way.

In a few cases, individual children scored above ceiling on particular sub-tests of the WPPSI-R. These children were then subsequently tested on the WISC-III also. However, some participants scored above ceiling on some sub-tests of the WPPSI-R but below floor on some of the sub-tests of the WISC-III. In such cases it was decided that if participants reached ceiling on less than half the sub-tests but scored below floor on the WISC-III, they were assigned the WPPSI-R ceiling score for those items. On the other hand, if a participant scored above ceiling on more than half the sub-tests of the WPPSI-R, their score for WISC-III was used, even if that participant scored at floor level on some subtests of the WISC-III.

The WPPSI-R and the WISC-III have several performance subtests in common (Block Design, Mazes and Picture Completion). Geometric design and Object appear in the WPPSI-R but not in the WISC-II. The Coding and Symbol Search subtests from the WISC-III were substituted for these.



## APPENDIX F

## SCORE SHEET FOR LEGO HOUSE TASK

	points	possible	actual
door to front	2	2	
door correct orientation	1	1	
window to rear	2	2	
window correct orientation	1	1	
wall present	2	4	
wall at right angles to door and window	2	4	
wall correct length	2	4	
wall correct height	2	4	
per row interlocking bricks	4	24	
per row colour matched	1	12	
base used as roof	2	2	
correct orientation	1	1	
correctly centred	2	2	
per correct piece used on roof	1	5	
correct joins	1	5	
correctly centred on roof base	1	1	
at RHS of house	2	4	
at LHS of house	2	4	
side pieces correctly joined	4	8	
accurate placement (relative to TM)	4	8	
colour matched	1	4	
leaves and petals joined	1	2	
per flower on side piece	1	2	
accurate placement	1	2	
colour matched	1	2	
fence to front of house	1	2	
fence to rear of house	1	2	
correctly positioned	1	4	
colour matched	1	4	
<b>TOTAL</b>		<b>122</b>	

## APPENDIX G

### DEFINITIONS FOR VIDEO CODING

#### Commencement and finish of coding

##### 1) Commencement

Coding was commenced as soon as one child picked up a brick and made to move it, regardless of what the other child was doing.

##### 2) Finish

The coding ended as soon as one of the following conditions was met:

- a) the model was an exact replica of the target model (TM);
- b) the model was not an exact replica of the TM but was completed to the satisfaction of both participants, the researcher should have reassured that this was the case by asking each participant individually;
- c) the time exceeded 15 minutes from commencement of coding.

#### Behavioural categories

All behavioural categories were mutually exclusive and came under 3 headings: level of task engagement, non-verbal behaviour and verbal behaviour.

##### Behavioural category 1: Level of task engagement

Engagement was a category which was intended to provide an overview of what percentage of the total time, participants spent engaged with the task and furthermore what percentage thereof could be considered to be collaborative engagement. Three mutually exclusive states were possible: on-task (working individually), on-task (working collaboratively) and off-task.

The participant was considered to be on-task when they were actively involved with the task in one of the following ways:

- by adding bricks to the model
- removing bricks from the model
- constructing a part of the model to one side that would later be added to the model (e.g. flowers, roof). Note that whether a participant was judged to be on-task or not was not based on correctness; if a child was making a part of model to one side that did not resemble the model but then added that part to the model, the behaviour was still coded as on-task. Making parts to one side that were not subsequently added to the model (e.g. randomly sticking bricks together) was not considered to be on-task behaviour
- pointing out mistakes on the children's version of the model without explicit reference to the TM
- pointing out features on the TM or highlighting discrepancies between the TM and the children's version of it.

Being on-task was considered to be a string of task-related behaviour, rather than an act. Thus a string of on-task behaviour might have included short pauses (10 seconds or less) in which the participant was not actively engaged but appeared to be considering an aspect of the task. In such 'breaks' the child could be relatively inactive but still engaged with the task mentally (e.g. when thinking or considering where a brick goes). If such a break was followed by on-task behaviour this was coded as an on-task string. However, if the participant was inactive but appeared to be considering the task and the period of inactivity exceeded 10 seconds or was not subsequently followed by an on-task behaviour, this was subsequently coded as off-task behaviour.

On-task behaviour was split into two behavioural categories: on-task (working individually) and on-task (working collaboratively):

**i) On-task (working individually)**

The participant's behaviour was on-task (according to the definition given above), however no collaboration was taking place with the partner.

**ii) On-task (working collaboratively)**

On-task (working collaboratively) was defined as a state whereby both partners were on-task and were working to the same agenda or had the same goal. This state occurred when participants were:

- constructing the same part of the model (e.g. both adding bricks to a wall) or co-constructing a part (e.g. when one child held the stem for the other child to add the flower)
- discussing how a part of the model might have been constructed
- discussing parts of the TM

Note that joint engagement and engagement were mutually exclusive and as soon as the participants were no longer working on the same part of the model, coding switched to either on-task (working individually) or off-task.

**iii) Off-task**

Once all behaviours mentioned above have ceased, the participant was no longer considered to be on-task. In this state the participant was either:

- inactively watching the partner
- attending to researcher or objects in the room
- playing with bricks to one side/making an object that is not later added to the children's version of the model
- engaged in mainly off-task speech
- relinquishing control e.g. hand over a part to their partner then watch while the partner works.

The change from off-task to on-task began as soon as the child began moving a brick towards the children's version of the model. This was the case even if the child's action was blocked and not completed. If the child picked up a brick, but did not move to place it, this was not considered to be on-task behaviour. On-task behaviour ended when an action was completed, unless there was a short pause (less than 10 seconds) before another action began. This was then considered to be the beginning of a string of on-task behaviour. Lifting or fingering a brick was not considered to be the beginning of on-task behaviour if it did not lead to an action (i.e. if the participant put the brick back down). Note that off-task behaviour was not coded if it was initiated by the researcher, for example, by asking the participant to blow his/her nose.

## **Behavioural category 2: Non-verbal behaviours**

### **Eye contact**

The number of times a participant glanced at their partner was recorded, as well as the duration thereof. Each attempt was coded, whether or not the partner returned the eye contact. In some cases, the participants only glanced to the partner and the duration was less than the one-second interval that was coded by the computer clock. In such cases, the onset and offset time was recorded as a half second. Joint eye contact was recorded as the partner's glancing at each other simultaneously. Eye contact was then computed in the following way:

- i) number of times the participant glanced at the partner
- ii) total duration of time spent looking at the partner
- iii) number of times joint eye contact was made
- iv) total duration of joint eye contact

### **Physical conflict**

Any physical action which challenged the partner or made it difficult for the partner to engage with the task, and included the following:

- snatching or attempting to snatch a component that the partner was holding
- blocking the partner's access to either the base or Lego pieces by moving or pulling away the base, or pushing away the partner's hand or arm or by using the hands or body to physically prevent the partner reaching
- resisting partner's attempt to pull away or snatch Lego pieces either by pulling away or shielding Lego pieces.

## **Behavioural category 3: Verbal behaviours**

Speech was coded as an event rather than a duration. While a unit for speech coding would usually be a sentence, it could be an incomplete sentence, as long as the category to which that sentence belonged was still obvious (e.g. "Don't do it like that.. it's not..." was still obviously a command). A unit might also have consisted of more than

one sentence where the extra sentence did not add any extra meaning, or could not be considered to be a separate category (e.g. "You have to put it up there...Victor. Up there!").

Certain categories of speech were not coded. These included:

- noises (e.g. snorts, groans)
- single word responses to researcher's questions e.g. "Yeah", "No", "What?" (N.B. Multi-word responses to researcher's questions were coded as off-task solicited speech)
- exclamations including "There!" "Em" "Oops" "Oh no!"
- apologies

All verbal behaviours are fully defined overleaf.

### Goal-directed

Under goal-directed come categories of speech which are directly task-related and which contribute to the carrying-out of the task.

category	description
commands	An utterance through which one participant instructed the partner to carry out a task-related act (e.g. "Do it like this" "You do the other one" "Wait!" "Put them there" "Why don't you do it then?"). Any non-task related demand was coded under 'negative personal comments' (e.g. "Sit down!" "Be quiet!").
descriptive/procedural/ planning	Any speech which: a) described parts of the model (e.g. "These fences are yellow"). b) explicated the 'how to' of the task (e.g. "That goes there" "That gate fits beside the other gate" "I'm fixing this end"). c) explicated the speaker's thoughts/beliefs (e.g. "I think this goes over here"). d) showed an intended sequence or plan of action (e.g. "Let's try it the other way this time" "We'll do the same again").
questions	Any task related question directed at partner (e.g. "What do I do now?" "Have you done the wall?" "Where does this go?" "What's in there?" "What's wrong?" "Can you show me how to do it" "How did you do that?" "What have we done?").
reminders	Reminders were utterances which attempted to keep the partner on-task by reminding him or her of the goal of the task (e.g. "Remember, we need to match the colours". "Remember, do what she told us" "It needs to be the same" "We'd better hurry up" "We have to copy the same one" "You can't make it differently – that's not the game").

### Cognitive conflict

Under the cognitive conflict heading come categories of speech which are likely to promote cognitive conflict. All the categories of speech under this heading indicate that the speaker has compared two version of the task (either the children's version and the target model or their partner's opinion and their own) and has noted discrepancies between the two. Being confronted with an opposing viewpoint has been proposed in the Piagetian literature to lead to cognitive conflict.

category	description
contradiction/ disagreement	A verbal statement of disagreement with a statement made by the partner. Such disagreements/contradictions might invoke further discussion and draw attention to the fact that the partner had a differing viewpoint to the speaker (e.g. "No, it's not like that", "I don't think so").
pointing out mistakes	Drawing attention to the fact that a part of the children's model was not correct either factually, or in the opinion of the child. Such statements could serve to cause the listener to re-assess an internal image of the model (e.g. "Look that bit's got too many [bricks]" "That's wrong" "I don't think that's right" "It's not only blue" "Wrong way round").
target model as a point of reference	Utterances whereby the speaker used the target model as a reference, either to point out a discrepancy between it and the children's model, or to intimate how the children's model might progress (e.g. "Look, it's got the yellow fences at the front" "Look at the other side" "Look that's wrong" "Look at the big long gate" "See it's blue and yellow").



## Facilitators

Facilitators may be described as speech acts which promote collaboration and a positive working environment.

agreements	A verbal statement of agreement with a statement made by the partner (e.g. "OK, let's do it that way then" "You're right").
invitations	Any utterance which encouraged the partner to take part in the interaction either by joining in or by voicing an opinion (e.g. "Shall we do it this way?" or "What do you think?" "What else?" "Shall we?" "Isn't that right Annabel?" "Shall we put it there?" "OK Eddie?"). Unlike a question, an invitation did not request a specific type of information and might or might not require a response.
offers to help	Speech which indicated that the speaker had noted that partner was experiencing difficulty, and resulted in the speaker making an offer of help (e.g. "I'll show you" "I'll do it"). Note, in the absence of any obvious difficulty a statement such as "I'll do it!" was considered to be a command, rather than an offer to help.
positive personal	Utterances which made a positive statement about the partner, in terms of ability or personality (e.g. "You're good at that" or "I like you"). Under this heading also came more general praise (e.g. "Well done", "That's right" "That's good").

## reluctance to engage

Utterances which signalled a desire on the part of the speaker, either to not engage with the task or to quit the task.

category	description
request to quit	Any statement which signals that the child wishes to discontinue task (e.g. "I've had enough of this" "I want to go back up [to the classroom]" "I don't want to do this anymore").
excuse	Participant provided a reason for not engaging with the task or working to his or her full potential; often provoked by a prompt from researcher (e.g. "I'm watching" "I'm too tired" "My arm hurts").

The following types of speech were coded as individual categories:

### **negative personal speech**

An utterance, directed at the partner, which was mainly negative in nature, such as:

- *reprimand*  
Utterances which requested that the partner to stop undesirable behaviour (e.g. "Sit down!" "Stop talking!" "Be quiet!" "Stop that!" "Sshh!" "Don't be silly" "Not like that!").
- *blame*  
Blaming the partner for task difficulties/ failure (e.g. "It was Mark's fault" "He can go back up if he can't do it" "I'm doing all the work and you're not helping" "You've taken up too many bricks").
- *teasing*  
Utterances which were said in a playful manner but had negative undertones (e.g. "Silly, silly Sam" "Silly Billy" "Slow Coach").
- *insult*  
Offensive or insulting utterances (e.g. "Stop, idiot!" "You're stupid").

### **rebuttal of help**

An active refusal to accept an offer of help/advice (e.g. "I know, I know!" "It's fine" "Leave it!" "I can do it myself!" "Cause, I just know it!").

### **off-task**

Utterances that were directed at either the partner or the researcher but not concerned with the task. (e.g. "Are you married?" "Animal Hospital is my favourite" "I've got a boyfriend", "Baby Spice, baby Spice" "Where do you live?" ).

This code was modified as solicited or unsolicited. Off-task speech was solicited when the researcher had asked the child a direct question. It was coded as unsolicited when the child began off-task speech spontaneously or began another statement when the researcher had acknowledged the child's previous statement but had not asked for another response.

### **Researcher directed**

This category comprised of utterances which were task related but which were directed at the researcher, not the partner and consisted of the following:

- *requests for affirmation and/or praise (affirm)*  
Utterances which require the researcher to reassure the speaker or confirm the correctness of an action (e.g. "Am I doing good?" "That's OK to do it like that isn't it?" "It goes there doesn't it?").
- *requests for help (help)*  
A request for the researcher to assist with the task (e.g. "Can't you just help us?").
- *requests for task-related information (task-related)*  
An utterance which requested that the researcher provide information to aid with the completion of the task (e.g. "How did *you* do this?" "How does that work?").

### **task-negative**

During task difficulties some children externalised their inability to complete the task by referring to the task in a negative manner (e.g. "It's a stupid house!" "This is horrible").

### **task modification**

Utterances which express a desire to change the task requirements (e.g. "We're not making our house like yours, it's going to be different" "Can't we just make it the way we want?" "We're making a different house" "We're making ours lovelier than yours" ).

### **'other '**

Utterances that were inaudible, incomplete, incomprehensible, or which did not fit into any other category.

## APPENDIX H

### DESCRIPTION OF TRIANGLES AND PATTERN CONSTRUCTION

#### SUBTESTS

##### **Triangles subtest**

**(Kaufman Assessment battery for Children (K-ABC: Kaufman & Kaufman, 1983)**

Recommended age range: 4;0-12;6

**Materials:** Nine identical triangles, each with a yellow side and a blue side  
**Description:** The child copies a design using the triangles. The design is demonstrated in easier items by the examiner, then is represented pictorially in later items. The score is based on accuracy and speed. Teaching items are available.

##### **Pattern Construction subtest**

**(British Ability Scales II (BAS-II: Elliott, 1996)**

Recommended age range: 3;0-17;11

**Materials:** Set A Six black and yellow foam squares  
 Set B Nine black and yellow plastic cubes  
**Description:** The child copies a design by putting together flat squares or solid cubes with black and yellow patterns on each side. The designs are represented pictorially in earlier items and are copied using the flat squares from Set A. Later, more difficult items are represented pictorially, and are copied using the plastic cubes from Set B. Teaching items are available.